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Education

VOLUME XIII No.4 - 1961

Education abstracts

THE UNIVERSITY OF MICHIGAN
JUL 23 1962
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Training of Science Teachers for Secondary Schools

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Education Abstracts is published four times a year
Annual subscription : $2.00; 10/-(stg.); 7 NF
Single copies : $0.60; 3/-(stg.); 2 NF

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Field workers, research students and others engaged or interested in education are invited to send in to the Education Clearing House, Unesco, documents, textbooks and other technical materials for possible inclusion in the Abstracts. Critical comments and suggestions will also be most welcome as a means of improving our service.

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ED.62.XI.128 A

Printed in 1962 in the Workshops of Unesco
Place de Fontenoy - Paris-7e - France
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PREFACE

There is no need to justify the choice of the present title as a subject for Education Abstracts. *Despite the importance of science teachers in education today, it appears from this survey that specialized literature on their training and work is still scarce. The Secretariat addressed to all National Commissions for Unesco a questionnaire asking for legislative and administrative documents (on science curricula in schools, training and qualifications of teachers, standards for equipment); publications on pre-service and in-service education of science teachers; and manuals or guides for science teaching. Replies from Member States form the main part of this issue. The monograph prepared for the purpose by the science specialists of the United States Office of Education is fuller than other entries, and includes different categories; however, its value as a complete study is such that the text has been kept intact.*

The introductory essay was written by Mr. D.E.T. Decker of the Sierra Leone Department of Education. In treating the question, Mr. Decker is able to describe and analyse the practices he has observed in different countries, while bearing in mind the particular needs of developing States like his own.

The Secretariat wishes to thank Mr. Decker and the national authorities for their collaboration.

The following countries are represented in this issue:

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Federal Republic of Germany
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Luxembourg
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Pakistan
Sudan
Sweden
United Arab Republic
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Uruguay
Viet-Nam

THE TRAINING OF TEACHERS FOR SCIENCE TRAINING AT THE SECONDARY LEVEL

by
D. E. T. Decker, Ministry of Education, Sierra Leone

The training of science teachers is now a very important concern of all countries and especially of newly-independent countries in process of development. Plans for the economic, social and industrial advancement of these countries call for personnel with scientific training, and some knowledge of science is also indispensable to an understanding of the everyday problems of present-day life. This is reflected in the secondary schools, where there is a great and growing demand for a scientific education. The demand becomes a problem because, at present, science teachers are too few and recruitment is handicapped by the low salaries paid to teachers as compared with similarly qualified persons in industry.

In many countries in Asia and Africa the problem is aggravated by the fact that while, in the past, recruitment from abroad was fairly easy, the present demand for science teachers in their own home countries has greatly limited the number of qualified applicants from abroad for science teaching posts. The excess of demand over supply has made the need for training such teachers everywhere a matter of urgency.

A teacher must be a leader. He must be highly qualified academically and professionally and have a good cultural background. His academic training should start in the secondary school and continue through the university. At the secondary school stage, he should learn the essentials of scientific method, reach the level required for the University Entrance Examination, preferably in three science subjects, a high standard in the language used as medium of instruction in the university and have at least a working knowledge of one other modern language.

At the university level, training should be both theoretical and practical. Theory should include lectures, the writing of essays on scientific subjects, and tutorials in small groups; practice should entail laboratory work carried out by the students themselves. Since great emphasis must be laid on laboratory work in the teaching of science in secondary school, it is essential that the trainee teacher develop a high level of competency in laboratory technique.

The university courses vary, but usually the student is required to perform certain scheduled experiments, often with the aid of laboratory manuals, to confirm information given at lectures. This does not give sufficient practice to the trainee teacher. He should also undertake a small research project which would give him a true insight into a scientific problem and practice in analysing that problem and formulating experiments leading to its solution. An exercise of this kind would give the trainee a clear understanding of the scientific approach, help develop in him the confidence that is essential for his career and better equip him to convey to his pupils the realities of scientific work.

In many universities courses are designed to produce specialists in one subject; conflicting views are held as to whether this is the best training for science teachers in secondary schools. Those in favour of such courses argue that specialist training provides the best background for effective school teaching, and is necessary for a teacher who will be guiding pupils to continue their own studies in the subject. This argument would be tenable in cases where future teachers must prepare pupils for scientific work in universities or institutions of higher education - or where there are enough qualified science teachers to allow for six or more in each secondary school.

In my opinion, however, it is undesirable for a secondary school science teacher to be a one-subject specialist. In the secondary school, science should be introduced to the pupils as a comprehensive whole, and to this end an integrated course, such as that provided by general science, is desirable. During the first two years topics from physics, chemistry, and biology should form a general science syllabus and, to obtain maximum benefit, the teaching should be done by one teacher. In such a setting the one-subject specialist can be of little help. The specialist teacher is well suited for work in the advanced classes but, while all pupils entering secondary school must be given an education which includes science subjects, only a relatively small number take science up to the advanced level so that the demand for sixth form science is small. The current shortage of science teachers is another reason why those available should be able to cover a wide range of science subjects. But the science teacher, while qualifying in more than one subject can reach a sufficiently high level in at least one of them to be able to teach the advanced classes with confidence. At the university, therefore, at least two science subjects, selected preferably from two of the main branches of science taught in school, physics, and chemistry and biology, should be studied to a high level.

Courses providing such training leading to the

general honours degree are offered by some British universities; the student studies three science subjects up to a fairly high level, and is well equipped to teach the subjects to the ordinary level of the General Certificate of education, and at least one of them up to the advanced level. Alternatively, intending teachers should take an examination of general honours standard before proceeding to special honours degrees. The student completing these studies has sufficient knowledge to teach at least two subjects throughout the school, and also to specialize in one.

The professional training of the science teacher should take place in a post-graduate training school attached to a university. The course should last for at least one academic year, and include both theoretical and practical training. In planning the course certain guiding principles should constantly be kept in mind.

1. Educating children is a profession. It is therefore important to develop in the trainee teacher a professional attitude towards his work.

2. Education must be child-centred; teaching the child is the most important aspect of the profession, not teaching the subject. A course in educational psychology is therefore desirable.

3. Education must be looked upon as a social science. The student should be well-informed about the educational system of his country and the historical and social forces which have shaped and influenced it. He should be trained to observe the social changes in his community and to seek ways of revising the system to meet changing social conditions. Hence, he should study the history of education of his country.

4. He must develop the necessary general skills and techniques of teaching and, in particular, those relevant to his own subject. He should be trained in methods - general and special - and given practice in other activities which may be ancillary to his classroom and laboratory work, e.g. making and repair of apparatus and collection, preservation and storage of biological materials.

5. Principles of education, and where possible, history of scientific thought should also be taught.

Opinions have differed as to whether theory should precede, or should evolve from, practice. In certain countries, students go through a purely theoretical course and then teach in a school under the supervision of members of the staff and occasionally of visiting inspectors. Such students are expected to learn on the job, putting, it is hoped, their theory into practice. After a certain period of teaching, when they are considered to have acquired the skills and techniques of teaching they are certified as qualified teachers. This system is, at best, doctrinaire.

A second system, which has gained much popularity in France, is described as "theory arrived at progressively through practice". Selection through a competitive examination leads to admission into the "Centres pédagogiques régionaux", where students are divided into teams of three, each under three counsellors with whom they follow a nine weeks course consisting of:

Observation: The students listen to lessons arranged and conducted by the counsellors.

First Active Phase: By degrees the counsellor gives each student responsibility for a lesson or part of a lesson, so that he gradually applies elements of teaching acquired in first phase.

Second Active Phase: The student teaches a given subject under the supervision of his counsellor. At this stage he is expected to use the whole range of teaching technique he has acquired during the course.

This system has its merits in that the student learns his work by real practice and may learn to use some methods and techniques of teaching. Teaching under supervision also reduces the number of elementary mistakes which are likely to be made by students in their first posts. But acquisition of skills and techniques does not constitute sufficient training for a professional teacher. He should have a fairly high level of knowledge of educational psychology to be able to understand and guide his pupils, and such knowledge cannot be gained from discussions on lessons taught or built up from teaching practice. Further, experience shows that students who have practically no knowledge of the processes involved in teaching find it very difficult to profit from observing lessons. Often they take little or no note of the techniques used by the teacher and, having no background knowledge, cannot appreciate the methods by which discipline is maintained in class. This introductory part of the training is therefore unlikely to produce a firm basis on which active teaching can be built.

In a third system the course is designed to develop theory and practice simultaneously. This has the merit of enabling the student to learn the theory and principles of education and educational psychology and try them out in practice, and to review and criticize his work as it progresses, in the light of his theoretical knowledge. This system is used with minor variations in different training departments, but the following plan appears to give the best results.

First phase: The students are given introductory lectures in the principles of education and child psychology and general lectures on methods, e.g. how to plan a lesson.

The next part of this phase should take the form of observation - listening to classes taught by experienced teachers, making notes in the light of the points they have learnt in their theoretical work, and discussing these points afterwards in small groups with their lecturer in tutorials.

At the end of this phase the student should do trial teaching under supervision of a methods counsellor and attended by possibly three fellow students who note their comments on his teaching. At the discussions following, both the points observed by the tutor and those noted by the student's colleagues should be discussed; care

should be taken to note the weak points and praise the good points in each trial lesson.

The Second Phase: In this phase emphasis should be on methods and school practice. Courses should be given in the teaching of special science subjects, including techniques of teaching, maintenance of apparatus and equipment, design of simple apparatus, collection, preservation and storage of materials, safety measures in laboratories, preparation of syllabuses, use of audio-visual aids. School practice should take the form of attachment to a secondary school, for a period not less than six weeks, working full time under the head teacher of the school and under the supervision of senior masters in the student's special subjects.

The amount of help given to the practising teacher during this period varies from one school or teacher to another. It is important that the class teacher, by advice and helpful criticism, should help the practising teacher to gain confidence and skill in teaching both in the lecture room and laboratory; he should also share fully in the life of the school.

The Third Phase: This final phase should include:

(a) Further courses in child psychology explaining facts already observed during practice teaching and giving fuller information regarding the development of the child and his learning processes.

(b) History of education dealing with the historical and social background of the school system in which the student will soon be engaged.

(c) A short dissertation written by the student on some educational problem encountered during his practice teaching.

This system has obvious advantages. It has not the doctrinaire character of the first system discussed and, unlike the second, gives the student a better opportunity of understanding the school child. The comprehensive nature of the course leads to the production of a true professional rather than merely a skilled craftsman. The student is given a clear understanding of classroom work and learns where to look for materials and how to organize his work.

Courses in the design and maintenance of apparatus and material are especially important for trainees who are likely to take up appointment in non-industrial countries. In many cases apparatus is in short supply and, in order to put the desired emphasis on practical work, the teacher will often have to design and construct simple apparatus to illustrate principles. In such places also, qualified artisans capable of repairing apparatus are often scarce, and the teacher has therefore to maintain the apparatus himself.

It is very important for the student-teacher to co-operate with other teachers as well as to learn to know his pupils. During his period of attachment to a school, he should be relatively independent of his college lecturers. He learns by experience, in staff meetings, the teacher's common-room and similar meeting places, to share views with other teachers and co-operate in the work of the school. In classroom, laboratory, playground, school clubs, etc., he meets and gets to know his pupils and learns how they react to different situations.

REFRESHER COURSES

A teacher should attain to a high level of education, and continue to improve himself both academically and professionally. He must keep in touch with improvements that are taking place as a result of research. If, after training, the teacher rests on his oars, he is likely to become stale and will soon fall short of the high standard required. He may keep pace by reading journals describing new ideas and techniques, but he will derive much more from personal contact with those engaged in such research and with other teachers who are trying out new techniques of improving the art of teaching. This is particularly important for the science teacher because of the rapid strides being made in scientific knowledge and the techniques used in laboratory work; likewise new and better apparatus and materials for carrying out experiments are being discovered. This contact can best be made during refresher courses for science teachers, held at universities and at training colleges.

All science teachers should be encouraged to undertake research and to share their discoveries with their colleagues at the refresher courses. University professors and research workers should be encouraged to explain to practising teachers what advances are taking place, and at workshops, preferably in the university, introduce teachers to new discoveries and new techniques for obtaining better results in laboratory work.

Principles of education need to be re-examined in the light of changing social conditions, and methods of teaching reassessed in the light of recent research in the psychology of education and of classroom experience. Presentation of topics by means of visual and auditory aids has much improved during the past few years; the refresher courses present a good opportunity for teachers to hear about these advances and actually to learn by working in audio-visual workshops. New techniques in the preparation, preservation and storage of biological material, experimentation with new physics apparatus and new materials and techniques for chemical analysis should all prove profitable. Laboratory work also should take an important place since, despite the emphasis given to it in secondary school teaching today, time does not permit any very broad training either at the universities and in the training colleges. Courses should be given in the planning and construction of laboratories for special subjects, designed to show how different arrangements can contribute to the effectiveness of the teaching.

Refresher courses can usefully provide information on the latest equipment available, the relative efficiency, durability and economy of such equipment, and how to prepare estimates and decide on priorities.

A course in science materials - materials needed and where to procure them, especially those not locally available should be included. In the teaching of biology in tropical areas, this is of particular importance, especially in procuring local types which very often are different from those described in textbooks and laboratory manuals.

Discussions on textbooks should be held, and where possible publishing firms should be invited to display school textbooks on different science subjects. Teachers will thus have an opportunity of comparing other texts with those used in their schools, and will perhaps find more suitable ones than those actually in use.

Short courses can often be arranged in nearby universities to help teachers in their research into one or other branch of their subject, and promising teachers should be given paid study leave to study in universities and colleges of foreign countries for about one year. Such opportunities will broaden their outlook and better equip them to improve the profession when they return home.

The future well-being of the modern nation depends largely on a steadily increasing supply of men and women trained in science. The foundations of such training must be laid in the secondary schools, where theory and practice must go hand in hand and greater prominence given to relating theoretical knowledge to practical work in the laboratory. This fact must be kept always in view in the training of science teachers, but it must never be forgotten that a good teacher must also be a highly qualified and cultured individual.

ARGENTINA

(Submitted by the National Commission for Unesco)

The general curriculum is mandatory for teachers of mathematics, physics, chemistry and biology. Detailed syllabuses also exist, but are not cited here because they are changed frequently. The teacher of a given subject is entitled to change his syllabus annually, in order to make it suit his experience, circumstances and scientific or educational progress.

The fundamental regulation on education fixes the level and scope of the teaching given in centres for training secondary school teachers; it also sets out conditions for promotion and certification. The same document indicates possibilities for in-service training for all secondary school teachers and, in particular, science teachers. The subject is treated also in the Teachers' Statute, under Article 6.

The future teacher finds in the secondary school "Planes y programas" an outline of what he should teach, a guide to teaching method, and the norms for setting up and maintaining a laboratory. This volume is of value also to teachers in service, who in addition receive instructions by circular from the Directorate-General of Secondary Teacher, Special and Higher Education. In the secondary schools the science teachers are grouped in one department, and decide themselves how they intend to carry out their own programme.

LEGISLATIVE AND ADMINISTRATIVE DOCUMENTS

Dirección general de enseñanza secundaria, normal, especial y superior. Planes y programas de estudio ... Buenos Aires, 1956. 364 p.

_____. Reglamento general para los establecimientos de enseñanza secundaria, normal y especial; texto ordenado. Buenos Aires, 1957. 217 p.

Ministerio del Interior. Estatuto del docente. Buenos Aires, 1958. 175 p. (Decreto reglamentario n° 17.003/57).

AUSTRALIA

(Submitted by the National Advisory Committee for Unesco)

LEGISLATIVE AND ADMINISTRATIVE DOCUMENTS

1. Plans, programmes and syllabuses of science teaching

Except in New South Wales, where a separate syllabus for each subject is published by the Education Department, the science syllabuses approved for use by the various State Education Departments are published annually in the public examination and matriculation manuals.

(i) New South Wales

New South Wales. Department of Education. Guide to post-primary courses, examinations and scholarships. Sydney, Government Printer. Annual.

(ii) Victoria

Melbourne University. Handbook of public and matriculation examinations, together with recommendations for courses of study. Melbourne.

(iii) Queensland

Queensland University. Manual of public examinations. Brisbane.

Queensland. Department of Education. Handbook of the junior public examination. Brisbane.

(iv) South Australia

Adelaide University. Manual of the Public Examinations Board. Adelaide, Part I, Regulations and syllabus; Part II, Examination papers.

South Australia. Education Department. Subjects and courses of study in high schools. Adelaide.

_____. _____. Science courses in boys' technical high schools. Adelaide.

_____. _____. General science courses in area schools. Adelaide.

(v) Western Australia

Western Australia. Public examinations manual. Perth.

(vi) Tasmania

Tasmania University. Matriculation manual. Hobart.

Tasmania Schools Board. Handbook of examinations. Hobart.

_____. Education Department. Course of study for secondary schools : science. Hobart, 1958.

2. Qualifications and conditions of service of teachers

Victoria. Education Department. Teaching. Melbourne. A brochure of the Education Department. A brochure of the Education Department.

_____. _____. Special method of teaching science. Melbourne.
Notes for use in the Technical Teachers' College.

_____. _____. Syllabuses for teachers' examinations.
Published in the Education gazette and teachers' aid, June, 1959.

_____. _____. Notes for the guidance of primary level teacher trainees in botany and zoology. Melbourne.
Issued for use in Teachers' Colleges.

South Australia. Education Department. Modes of entering the service and the training of teachers. Adelaide. (Circular no. 27).
Reprinted from the Education gazette, August, 1960.

Tasmania. Education Department. Notes on courses for teacher training. Hobart.

3. The provision and maintenance of laboratories

Queensland. Department of Public Works. Standard plans of a chemistry unit and a physics unit. Brisbane.

South Australia. Education Department. Notes on standard equipment (reagents and apparatus) for intermediate science (including physics, chemistry and general science). Adelaide.

_____. _____. Additional apparatus and chemicals for leaving chemistry. Adelaide.

DOCUMENTS RELATING TO THE IN-SERVICE TRAINING OF SCIENCE TEACHERS

In each State there are opportunities for the in-service training of science teachers. One State, New South Wales, is dealt with here in some detail, as an example of the types of training available.

The in-service training of science teachers is undertaken by the New South Wales Department of Education working in conjunction with the Universities and Teachers' Colleges, by the Science Teachers' Association, and by independent groups such as the Sydney Grammar School Science Association (a non-departmental school).

The Department of Education gives considerable assistance to practising teachers who wish to take up further University studies, either as evening or external students, to improve their qualifications. Details are provided in :

New South Wales. Department of Education. Assistance to teachers : university evening lectures and external studies, Sydney.

The Education gazette, 1905- . Sydney.
Published by the Department of Education and distributed to all teachers, this gazette gives information concerning post-college courses conducted by and held in the various teachers' colleges during vacation, and in-service series of lectures. Lectures, which spread over a week, are given by teachers, inspectors, college and university lecturers, and eminent outside authorities ; admission is free. Each series usually contains some courses of value to science teachers. At present the courses do not carry any credits towards gaining special attainment levels in the teaching service.
Details are provided in :

New South Wales. Department of Education. In-service courses for teachers - 1961 series : science courses. Sydney.

With Education Department co-operation, the Nuclear Research Foundation of Sydney University, New England University, and the University of New South Wales organize summer schools covering the fields of physics, chemistry and biology.
Documents relating to these summer schools are:

Sydney University. The Nuclear Research Foundation within the University of Sydney and the School of Physics. Sydney.

Messel, Harry. New deal in science education. Reprinted from The Australian Scientist, Vol. 1, no. 1, February 1961. p. 6-9.

Butler, Stuart Thomas ; Messel, Harry, (ed.) From nucleus to universe : a course of selected lectures in physics and astronomy. Sydney, Shakespeare Head Press, 1960.

Lectures contributed to the Nuclear Research Foundation Summer School for Science Teachers at the University of Sydney, 11 to 22 January 1960.

Butler, Stuart Thomas ; Messel, Harry (ed.). A course of selected lectures in physics and astronomy. Sydney. Shakespeare Head Press, 1961.
Lectures contributed to the Nuclear Research Foundation Summer School, 9-20 January 1961.

Aylward, G.H. ; Symes, F.S. (ed.). Approach to chemistry : lectures and workshop report of the 1961 Summer School for chemistry teachers at the University of New South Wales, Sydney. Sydney, Halstead Press, [1961].

Summer School for chemistry teachers. Sydney University, 1961.
Information concerning the summer school for chemistry teachers held at Sydney University, 9 to 13 January 1961.

Science Teachers' Association of New South Wales, c/o Moorefield Girls' High School, Kogarah, New South Wales, is an affiliated branch of the Australian Science Teachers' Association. Its various activities covering all aspects of science teaching are described in the following documents :

Science Teachers Association of New South Wales. Services to science teachers in New South Wales.
A typed sheet setting out activities of the Association.

Science Education News : the journal of the Science Teachers' Association of New South Wales, 1952- . Sydney, 3 issues a year.
Indexed in the Australian Education Index.

Science Teachers' Association of New South Wales. Sample answers for teachers, for leaving certificate physics and biology examination papers, 1960, prepared by members of the Science Teachers' Association. Sydney.

Conasta : the annual report of the Australian Science Teachers' Association. Sydney.

The Australian Science Teachers' Journal, 1955- . Sydney, Australian Science Teachers' Association. 3 issues a year.
Indexed in the Australian Education Index.

The Sydney Grammar School Science Association is an example of activity among non-departmental science teachers. Documents produced by this Association are :

The future of children
A pamphlet prepared by the Sydney Grammar School Science Association.

Conference on the Teaching of Chemistry
A record of lectures and discussions at a conference held at Sydney Grammar School, 19 and 20 August 1958.

Conference on the Place of Chemistry in General Education.
A record of lectures and discussions at a conference held at Sydney Grammar School, 18, 19 and 20 August 1959.

TEACHERS MANUALS AND GUIDES FOR SCIENCE TEACHING

Sydney Teachers' College. Physical science method.
Notes prepared at Sydney Teachers' College for distribution among students training as science teachers.

A Science bulletin for teachers in secondary schools. Sydney, New South Wales Department of Education. Irregular.
Containing contributions by practising teachers on topics relevant to the teaching of their subject. Copies of the bulletin are issued free to secondary schools.

Instructions and guidance are given in the prefaces to syllabuses included in the publications listed above.

GENERAL NOTE

As a guide to current publications see also :

Australian Education Index, 1958- . Melbourne, Australian Council for Educational Research.
This is a detailed alphabetical subject index to periodical and non-periodical publications in education ; Part 1 : Index to articles, books and pamphlets ; Part 2 : Information service (i.e. news items including brief comments on conferences, recent developments and instructions issued by State Education Departments). In both parts, under appropriate headings, such as Science, Scientific Education, Chemistry, Teachers, etc., there will be found a considerable amount of information about current publications on science teaching in Australia.

BULGARIA

(Submitted by the National Commission for Unesco)

All science teachers for general and vocational secondary schools in the People's Republic of Bulgaria at present receive their training at the State University of Sofia. In the future, they will be trained at the higher pedagogical institutes to be opened in accordance with the provisions of the Law for the establishment of closer relations between school and life and for the further development of public education in the People's Republic of Bulgaria.

For students taking the science teaching courses at the State University (mathematics, physics,

chemistry and biology), both theoretical and practical instruction is provided.

The practical work is done in study rooms and laboratories, on experimental plots, etc., equipped with modern apparatus and the necessary machines, accessories and installations. Practical work of a productive nature is likewise organized for the students so as to enable these future teachers to become familiar with the practical applications of the sciences they are to teach.

The course takes five years, and includes a practice teaching period during the last semester. It culminates in a State examination comprising scientific tests and ideological tests.

After passing his examination, which forms part of the university examination system, a candidate is considered to have completed his higher studies and is qualified to teach the science subjects covered by the examination at general secondary schools.

All teachers, including science teachers, take refresher courses covering the ideological, pedagogic, scientific and methodological aspects of their speciality. These courses are given every five years at advanced teacher-training institutes and in the pedagogical study rooms organized at "Instruction and Culture" sections. The teachers learn about all the latest ideas in their own scientific field and about new methods of school education. The curriculum includes class-work, practical exercises, seminars and conferences on science problems and practice, reading on pedagogic subjects, consultations and visits to enable the trainees to observe the work of experienced teachers. Visits to factories and co-operative farms are also organized, as well as excursions to sites of historical or geographical interest, large socialist projects, etc.

The duration of these refresher courses varies from 30 to 60 days for the class-work and from 12 to 20 days for the practical exercises and seminars. The period depends on the teachers' needs, the particular objects of the training course, the requirements of the curriculum and the type of subject studied.

The work of teacher trainees and of teachers taking the refresher courses is based on syllabuses, curricula and methodological instructions approved by the Ministry of Education and Culture.

WORKS ON NATURAL SCIENCE TEACHING

Kotzev, An. ; Janev, As. ; Bozarov, V. Metodika na estestvoznanieto. Sofia, Narodna Prosveta, 1952. 214 p.
Teaching method for the natural sciences.

Zaharieva, An. ; Popova, V. ; Pešin, M. ; Lalev, St. Metodika na estestvoznanieto. Sofia, Narodna Prosveta, 1953. 143 p.
Teaching method for the natural sciences ; manual for teacher-training establishments.

Petrova, El. ; Dejanova, Al. ; Semkova, M. ; Uzunova, N. Metodika za zapoznavane deteto s prirodata. Sofia, Narodna Prosveta, 1955. 210 p.
Method for acquainting children with nature.

Todorova, Zdr. ; Zaharieva, An ; Paskova, R. ; Barova, P. Metodičeska razrabotka na temi po zoologia. Sofia, Narodna Prosveta, 1958. 140 p.
Development of zoological topics from the standpoint of teaching method.

Todorova, Zdr. ; Paskova, R. Metodična razrabotka na pregovorni uroci po biologia i geologia. Sofia, Narodna Prosveta, 1956, 95 p.
Lessons for reviewing biology and geology, from the standpoint of teaching method.

Paskova, R. Metodično pismo za prepodavane temata "Nervna sistema" ot anatomia i fiziologia na coveka za srednite učilišta. Sofia, Narodna Prosveta, 1955. 45 p.
Instructions for secondary schools on teaching about the nervous system in human anatomy and physiology.

Kotzev, An. ; Kozarov, G. ; Karageorgiev, K. Răkovodstvo po anatomia i fiziologia na čoveka. Sofia, Narodna Prosveta, 1949, 180 p.
Manual for the teaching of human anatomy and physiology.

Bojčinov, Zdr. ; Natchev, N. ; Giurovski, Al. Laboratornite zanjatia po anatomia i fiziologia na čoveka. Sofia, Narodna Prosveta, 1959. 221 p.
Laboratory work for the teaching of human anatomy and physiology.

Dočeva, Dr. R. ; Jakov, Il. Răkovodstvo za praktičeska rabota po botanika. Sofia, Narodna Prosveta, 1955. 196 p.
Manual for practical work in botany.

Angelov, An. Răkovodstvodo za naprava na sbirki po estestvoznanie. Sofia, Narodna Prosveta, 1952. 88 p.
Manual for the preparation of natural science collections.

Jordanov, M. ; Minčeva-Stefanova, I. Geološki Ekskurzii. Sofia, Narodna Prosveta, 1960. 262 p.
Geological excursions.

Velev, St. ; Kukuševa, R. Polska praktika po botanika. Sofia, Narodna Prosveta, 1957. 215 p.
Practical field work in botany.

Angelov, An. ; Boev, N. ; Karkojitska, N. ; Stoyanov, St. Polska praktika po zoologia. Sofia, Narodna Prosveta, 1957. 246 p.
Practical field work in zoology.

Zaharieva, An. Ekskurzii v selskoto stopanstvo. Otrasal zivotnovadstvo. Sofia, Narodna Prosveta, 1960. 56 p.
Visit to a farm : animal husbandry.

Mitrev, K.R. Učebno opitno pole. Sofia, Narodna Prosveta, 1960. 46 p.
Experimental school plots.

MANUALS FOR PHYSICS TEACHING

Markov, D. ; Paunova, A. Răkovodstvo za opiti i demonstračii po fizika. Sofia, Narodna Prosveta.
Manual of experiments and demonstrations in physics (intermediate and higher course for polytechnic schools and technicums).

Targov, P. ; Makedonski, D. Kražočnata rabota po fizika. Sofia, Narodna Prosveta.
The authors of this work describe the results of five years' experience in study groups for physics ; they outline the kind of work done in these groups and explain the teaching methods to be applied in them.

Markov, D. ; Paunova, A. Laboratorni upražnenia po fizika. Sofia, Narodna Prosveta.
Laboratory exercises included in the curriculum for secondary polytechnic schools.

Tasseva, O. ; Karamitrov, St. ; Goranaova, St. Metodika na obučenieto po fizika. Sofia, Nauka i Izkustvo.
This book is divided into a general and a special section. The former deals with the aims of physics teaching, the physics curriculum, the organization of courses and teaching methods, polytechnical studies, etc. The second section is devoted to teaching methods suited to the various subjects dealt with in polytechnical schools.

MANUALS FOR TEACHING CHEMISTRY

Angelova; V. ; Galabov, Iv. Metodika na obučenieto. Sofia, Nauka i Izkustvo, 1960.
This manual for chemistry students taking teacher-training courses may also serve as a guide for chemistry teachers at polytechnical schools and technicums.

Bončeva, B. ; Tzokova, V. ; Hristoforova, V. Metodična razrabotka na urocite za himičnite proizvodstva. Sofia, Narodna Prosveta, 1958.
Teaching method for lessons on chemical products.

Penev, A. Onagledjavane izučavaneto na himičnite proizvodstva. Sofia, Narodna Prosveta, 1960.
Visual aids used in the study of chemical products.

Tzokova, V. ; Bončeva, B. ; Mitkov, Iv. Laboratornata rabota po himia v obštoobrazovatelnite učilišta. Sofia, Narodna Prosveta, 1957.
Laboratory work in chemistry for general education schools.

Galabova, Iv. ; Penev, A. Obzaveždane i ureždane kabineta po himia. Sofia, Narodna Prosveta.
Equipment and installation of chemistry study rooms.

Bončeva, B. ; Hristoforova, V. et al. Ekskurzia po fizika i himia v proizvodstveni predprijatia. Sofia, Narodna Prosveta.
Visits to factories as a part of physics and chemistry teaching.

Karamihov, St. ; Ilieva, M. Učebna proizvodstvena praktika po fizika i himia v promišleno predprijatie.
Practical production work (physics and chemistry) in factories.

BYELORUSSIA

(Submitted by the National Commission for Unesco)

Teachers of science in Byelorussia are trained in the respective faculties of the institutes of education, and in addition, the faculty of biology of the State University also admits teacher-trainees.

Students in the chemistry and biology faculties study the following subjects (in addition to general education subjects) : inorganic chemistry, analytical chemistry, organic and biological chemistry, organic synthesis, the bases of physical and colloidal chemistry, the bases of chemical technology, methods of teaching chemistry in schools ; botany, zoology, histology and embryology, plant physiology and the bases of microbiology, human anatomy, human and animal physiology, Darwinism, plant and animal geography, methods of teaching biology, the bases of agriculture, including mechanization ; geology, physics, and the use of educational films. In addition to these subjects, which are compulsory, students have to choose three or four optional subjects from a list including plant ecology, animal ecology, nature preservation, genetics of plant and animal selection, agricultural entomology, apiculture, minerals, chemistry of complex compounds, and the preparation of visual teaching aids.

The programme of the natural sciences and the geography faculty comprises practically the same subjects, except that the chemistry cycle is replaced by a wide variety of geographical subjects.

Details on the teaching of individual subjects are given in special programmes to which are appended lists of the main textbooks and teaching aids. Students taking the senior courses at the University specialize in subjects of their own choice ; plant physiology, botany, Darwinism, microbiology or animal physiology.

For teachers already teaching natural sciences in schools, there is a correspondence study system, whereby they attend one-month courses twice a year, spending the rest of the time in independent study. For the training of future biology teachers Byelorussia uses the same textbooks and teaching aids as the other Republics of the Soviet Union, but special local teaching aids have also been produced by professors of the Byelorussian State University.

COSTA RICA

(Submitted by the National Commission for Unesco)

Costa Rica. Universidad. Planes para la formación de profesores de segunda enseñanza. San José, Ciudad universitaria, 1960. 15 p. illus. (Publicaciones de la Universidad de Costa Rica, serie misceláneas, no. 49).

_____. _____. Programa de emergencia para profesores de segunda enseñanza en servicio. San José, Ciudad universitaria, 1960. 16 p. (Publicaciones de la Universidad de Costa Rica, serie misceláneas, no. 50).

FINLAND

(Submitted by the National Commission for Unesco)

TRAINING TEACHERS OF NATURAL HISTORY (BOTANY AND ZOOLOGY) AND GEOGRAPHY

A Decree of 1941 established secondary school curricula and school records; instructions on method were approved the same year.

In the 5-year lower secondary schools the curriculum provides for 21 hours per week of botany, zoology and geography, half of this time to be used for geography teaching. In the 3-year upper secondary schools the corresponding figure is 6 hours per week, half of the time being used for geography teaching. At grammar schools (only a few exist in Finland) the corresponding figure is 22 hours in five lower classes and none at all in the three upper classes.

The instructions on method regulate what must be taught in each subject. Generally speaking botany and zoology are taught in the five lower grades; in the three upper grades the subject is called general biology. Teaching of geography in the five lower grades covers district geography, basic general geography and the geography of the native country; in the three upper grades general geography is taught.

A person can be appointed teacher if he is 21 years old, a Finnish citizen, respectable, known for correct conduct and has no physical defect or illness which could unfit him for the teaching profession.

Other qualifications are: training at a normal secondary school, i.e., a secondary school offering a two term teacher-training course leading to a degree in pedagogy in the school's teaching language; for a position in a normal secondary school, the candidate must pass tests of teaching skill with laudatur (highest) marks.

Qualifications for the position of chief instructor (only in normal secondary schools) are: a degree of Master of Arts with laudatur in geography, and either laudatur in botany and cum laude approbatur in zoology, or vice versa, or laudatur in genetics and cum laude approbatur in zoology and botany.

Qualifications for the older secondary school teacher's post are: a degree of Master of Arts with laudatur either in botany, zoology or geography and cum laude approbatur in the two other subjects, or laudatur in genetics and cum laude approbatur in each of botany, zoology and geography.

Qualifications for a younger secondary school teacher's post are: a degree of Master of Arts with cum laude approbatur in botany, zoology and geography.

In addition to these qualifications all teachers of natural history and geography must have a knowledge of plants and animals of university standard and must complete the course in ecology.

The area of the classroom is about 70 sq. metres and, in addition to the usual classroom furniture, a map stand is obligatory and facilities for the use of a projector. To store this equipment extra space of about 30 sq. metres must be available.

During summer and Christmas holidays series of lectures, excursions (also abroad) and continuation courses are organized for teachers.

Relevant publications are:

Soveri, Jorma. Kasviopin opetus luonnossa. (Science teaching in nature). Helsinki, Otava, 1947. 86 p.

Tahvonen; Kontuniemi. Opettajan Vihjekartat. (Teacher's maps). Porvoo-Helsinki, Werner Söderström Oy, 1961. 348 p.

TRAINING TEACHERS OF PHYSICS AND CHEMISTRY

Curricula and method instructions were fixed in 1941. At present the teaching of physics and chemistry is given the following time (in hours per week):

	Lower secondary school		Upper secondary school and Grammar school		
	IV	V	VI	VII	VIII
8-year Secondary school for boys and co-educational secondary school with two streams *					
Boys	4	4	3	3	3
Girls	3	3	3	3	3
Grammar school		2	2	2	2
	V	VI	VII	VIII	IX
9-year secondary school for girls	3	3	2	2	2

* In many secondary schools instruction during the upper secondary school course is divided in two streams: modern or practical, and linguistic.

Chemistry is studied in the fourth grade of lower secondary school and physics in the fifth. In the upper secondary school course, chemistry is studied in the seventh grade. What is to be studied in each subject in each grade is fixed in the instructions on method.

Qualifications for teachers resemble those set out above. The position of chief instructor requires the degree of Master of Arts with laudatur in physics and cum laude approbatur in chemistry and pedagogy.

Qualifications for the older secondary school teacher's position : the degree of Master of Arts with laudatur in both physics and chemistry. In schools where no extra course in chemistry is given in the higher grades (grammar schools and secondary schools for girls) approbatur (lowest marks) in chemistry is sufficient.

For the younger secondary school teacher's position the degree of Master of Arts is required with at least approbatur in physics and chemistry.

The area of a classroom is about 64 sq. metres and it must have the necessary demonstration equipment installed on the teacher's table. In most schools there is a separate work room for about 20 pupils. Two pupils usually work together.

For further information refer to :

Malmio, Bruno. Luonnonopin opetus Suomessa. (Teaching of Natural Sciences in Finland). Helsinki, Otava, 1933. 244 p.

FRANCE

(Submitted by the Institut pédagogique national)

TIME-TABLES AND SYLLABUSES FOR SCIENCE TEACHING

The time-tables and detailed syllabuses for science teaching (mathematics, physics, chemistry, natural sciences) for each class at secondary schools are given in : Horaires et programmes de l'enseignement du second degré. Paris, Vuibert, 1959. 210 p.

RECRUITMENT OF SCIENCE TEACHERS

Science teachers must at least hold a licence in science qualifying the holder to engage in teaching.

The licence, which is studied for at the Science Faculty, after obtaining one of the three certificates for higher studies marking the completion of the first cycle of higher education, offers a choice of eight electives :

1. Mathematical sciences
2. Applied mathematical sciences
3. Physical sciences (speciality : physics I)
4. Physical sciences (speciality : physics II)
5. Physical sciences (speciality : chemistry)
6. Natural sciences (speciality : biological sciences).
7. Natural sciences (speciality : earth sciences)
8. Chemistry, Physiology

Direction de l'enseignement supérieur. Licence ès sciences d'enseignement. Epreuves - horaires - programmes. Paris, Institut pédagogique national, 1958. 32 p., supplements.

This pamphlet gives particulars of the tests, time-tables and curricula for the various licences.

Science teachers are recruited from among holders of a teaching licence either by virtue of their academic qualifications or by competitive examination.

Recruitment based on degrees. Depending on the posts to be filled, holders of the teaching licence may be appointed to assistant teaching posts without having to sit for an examination.

They are appointed by the Minister. A point to be noted is that the shortage of staff has led the Ministry to recruit science teaching staff for the time being on a contractual basis. See on this subject :

Ministère de l'éducation nationale. Recrutement d'agents contractuels pour les enseignements scientifiques dans les établissements du second degré et de l'enseignement technique. Décret du 13 août 1957. Paris, Institut pédagogique national, 1957. 14 p.

Recruitment by competitive examination. Teachers with the rank of professeur must have passed either the competitive examination for agrégation or that for the C.A.P.E.S. (Certificat d'aptitude au professorat de l'enseignement secondaire) (Secondary teaching certificate).

The examination for agrégation or the C.A.P.E.S. may be prepared for either in one of the teacher-training colleges, which recruit by competitive examination and likewise train secondary teachers, or at the Faculty.

Institut pédagogique national. Les agrégations du second degré. Paris, 1959. 23 p. (Dossiers documentaires. Information Series, January 1959, no. 4).

_____. Les écoles normales supérieures relevant de la Direction de l'enseignement supérieur. Paris, 1959. 21 p. (Dossiers documentaires. Information Series, June-July 1959, no. 4).

_____. Certificat d'aptitude au professorat de l'enseignement du second degré (C.A.P.E.S.) et centres pédagogiques régionaux (C.P.R.). Paris, 1958. 37 p. (Dossiers documentaires. Information Series, December 1958, no. 3).

SALARIES - PROMOTION

Institut pédagogique national. Enseigner ... pourquoi pas? Paris, undated, 31 p.

This pamphlet gives particulars about promotion and salaries of assistant teachers, certificated teachers and teachers who have passed the agrégation examination. The salaries of public officials have been raised by approximately 5% since the pamphlet appeared.

TRAINING OF SCIENCE TEACHERS

The training of secondary teachers has traditionally been directed towards intellectual rather than towards pedagogic preparation. Access to the teaching profession was conditional on passing a competitive examination: the agrégation.

Educators have been conscious of this inadequacy, and have tried to give greater importance to pedagogic preparation.

The Decree of 1 April 1950, supplemented by that of 17 April 1952, created the "Certificat d'aptitude au professorat du second degré" (C.A.P.E.S.) or secondary teacher's certificate, which provides for proper pedagogic training. A decisive step was taken in 1952 by the establishment of regional pedagogic centres (Centres pédagogiques régionaux, or C.P.R.), and in 1957 of the institutes for preparation for secondary teaching (Instituts de préparation aux enseignements du second degré, or I.P.E.S.), for initiating prospective teachers into their future profession.

Institut pédagogique national. Les instituts de préparation aux enseignements du second degré. Paris, 1958. 11 p. (Dossiers documentaires. Information Series, November 1958, no. 5).

Meanwhile, in an age where a people's living standard is generally recognized to be largely dependent on its level of education, pedagogic research has everywhere assumed growing importance.

Hence the conferences, symposia and educational meetings of all kinds, which have been held at both the regional and national levels, with the aid of the Institut pédagogique national and the regional centres for educational documentation: national seminars at the Centre international d'études pédagogiques, Sèvres, regional seminars, educational publications.

Among the principal recent publications on this subject are the following:

Brunold, Charles. L'enseignement scientifique du second degré; contribution à la définition de l'esprit et des méthodes de cet enseignement. Paris, Institut pédagogique national, 1960. 109 p. (Institut pédagogique national, Brochure no. 146 EP/Sd).

Direction de l'enseignement du second degré. Instructions concernant l'enseignement des mathématiques. Programmes. Paris, Institut pédagogique national, 1959. 66 p. (Institut pédagogique national, Brochure no. 106 EP/Sd).

_____. Instructions relatives à l'enseignement des mathématiques, des sciences physiques, des sciences naturelles, de l'histoire et de la géographie dans les lycées et les collèges. Paris, Institut pédagogique national, 1957. 71 p. (Institut pédagogique national, Brochure no. 133, EP/Sd).

'L'enseignement des mathématiques'. Special issue: Cahiers pédagogiques pour l'enseignement du second degré, (Paris), 15th year, no. 21, 15 May 1960. 100 p.

'Formation littéraire des scientifiques'. Cahiers pédagogiques pour l'enseignement du second degré, (Paris), 15th year, no. 15, 15 October 1959, p. 4-16.

PHYSICS - METHODS AND TECHNIQUES - GENERAL REFERENCES

Bachelard, Gaston. Le nouvel esprit scientifique, Paris, Presses universitaires de France, 1946. 182 p. (Nouvelle encyclopédie philosophique).

Encyclopédie française. Paris, Société de gestion de l'Encyclopédie française, 1935. Vol. II: "La physique", 1955. Director: Louis de Broglie.

Lazerges, Guy. 'Les techniques de la classe'. Cahiers pédagogiques pour l'enseignement du second degré, (Paris, 12th year, no. 1, 15 September 1956, p. 1-16.

_____. 'Méthodes, expériences, travaux pratiques'. Cahiers pédagogiques pour l'enseignement du second degré, (Paris), 14th year, no. 9, 15 October 1958, p. 6-31.

_____. 'Enseignement et organisation du travail dans les sciences physiques'. Cahiers pédagogiques pour l'enseignement du second degré, (Paris), 9th year, no. 3, 15 December 1953, p. 142-148.

Marck, P. 'L'enseignement des sciences physiques'. L'Education nationale, (Paris), no. 34, 26 November 1959, p. 13-14.

Nicolai, A.H.; Ricci, André. 'Sur l'enseignement de la physique'. Cahiers pédagogiques pour l'enseignement du second degré, (Paris), 10th year, no. 8, 15 May 1955, p. 679-681.

Peschard, Marcel. 'La pédagogie des sciences physiques'. L'Education nationale, (Paris), no. 14, January 1954, p. 6-9.

Zadou-Naisky, Georges. Les sciences physico-mathématiques dans l'enseignement. Paris, Presses universitaires de France, 1954. 144 p. (Nouvelle encyclopédie pédagogique).

EXPERIMENTS - PRACTICAL WORK - MATERIALS

Courtin, Madeleine. 'Sciences physiques et travaux pratiques'. L'Education nationale, (Paris), no. 23, 10 November 1949, p. 11.

Cupissol, Etienne. 'Travaux pratiques conçus et réalisés par les élèves'. Cahiers pédagogiques pour l'enseignement du second degré, (Paris), 10th year, no. 2, 15 October 1952, p. 124.

Huart, J. 'Les travaux pratiques intégrés dans l'enseignement de la physique'. Cahiers pédagogiques pour l'enseignement du second degré, (Paris), 14th year, no. 9, 15 October 1958, p. 32-45.

ACTIVE METHODS

Brunold, Charles. Esquisse d'une pédagogie de la redécouverte dans l'enseignement scientifique, Paris, Masson, 1948. 48 p.

Fléchon, Jean. 'La recherche collective en sciences physiques'. Education nationale, (Paris), 14th year, no. 16, 2 May 1958, p. 6-7.

CHEMISTRY

David, Suzanne. 'La chimie et la grande aventure du progrès scientifique'. Cahiers pédagogiques pour l'enseignement du second degré, (Paris), 13th year, no. 2, 1 November 1957, p. 12-14.

Le Révérend, Jean. 'Faut-il apprendre la chimie ?'. L'Education nationale, (Paris), no. 97, 1952, p. 42-64.

MATHEMATICS

Brunold, Charles. 'Pour une orientation concrète de l'enseignement des mathématiques'. L'Education nationale, (Paris), 13th year, 2 May 1958, p. 4, et Courrier de la recherche pédagogique, (Paris), no. 7, October 1957, p. 3-4.

Desforges, J. 'L'enseignement des mathématiques dans les classes du premier cycle'. L'Education nationale, (Paris), 14th year, no. 1, 2 January 1958, p. 4.

Fouché, André. La pédagogie des mathématiques. Paris, Presses universitaires de France, 1952. 143 p. (Nouvelle encyclopédie pédagogique).

Gal, Roger; Biquenet, Alphonse; Walusinski, Gilbert. Enquête sur le matériel d'enseignement des mathématiques. Paris, Institut pédagogique national, 1958. 48 p. (Institut pédagogique national, Service de la recherche pédagogique. Publications, 5).

'Initiation aux mathématiques'. Cahiers pédagogiques pour l'enseignement du second degré, (Paris), 14th year, no. 10, 15 November 1958, p. 26-46.

Piaget, Jean; Beth, E. W.; et al. L'enseignement des mathématiques. Neuchâtel, Delachaux et Niestlé, 1955. 175 p. (Actualités pédagogiques et psychologiques).

Soula, Julien. 'L'enseignement des mathématiques et de la physique'. Education nationale, (Paris), 15th year, no. 4, 22 January 1959, p. 3-4.

Walusinski, Gilbert. 'Comment enseigner aujourd'hui les mathématiques de demain'. Atomes, (Paris), 12th year, no. 139, December 1957, p. 371-377.

FEDERAL REPUBLIC OF GERMANY

(Submitted by Documentations und Auskunftsdienst, Pädagogische Arbeitsstelle)

Owing to the autonomy of the 11 "Länder" of the Federal Republic in matters of education, each "Land" has its own regulations, programmes and plans concerning the teaching of science and the training of teachers. The contents and aims of those programmes, however, are very similar, and consequently the relevant documents of one or two "Länder" may suffice as examples.

Hesse : Bildungspläne für die allgemeinbildenden Schulen im Lande Hessen, II D : Das Bildungsgut des Gymnasiums. (Amtsblatt des Hessischen Ministers für Erziehung und Volksbildung, Sondernummer 4). Wiesbaden, März 1957. Biology, p. 555-565; physics, p. 566-585; chemistry, p. 586-591.

Rhineland-Palatinate : Lehrpläne für die höheren Schulen des Landes Rheinland-Pfalz. (Herausgegeben vom Ministerium für Unterricht und Kultus). Grünstadt/Weinstrasse, Verlag E. Sommer, 1960. Physics, p. 218-227; chemistry, p. 228-235; biology, p. 236-245.

Science teachers for secondary schools are trained at universities and technical universities. In accordance with the principles of German universities, students are free to choose lectures and seminars. Therefore no obligatory study plans have been issued by the universities or ministries of education. Some universities, however, provide special seminars and practical exercises for

student teachers only, which pay regard to the typical needs of secondary schools. The intending teacher has to pass a State examination after having studied two or three subjects for at least 5 years. The ministries of education publish regulations for the State examinations containing the standards for teachers and their qualifications. For example:

Baden-Württemberg: Ordnung der wissenschaftlichen Prüfung für das Lehramt an Gymnasien. (Amtsblatt des Kultusministerium Baden-Württemberg, 4/1959), p. 214-216, (Physics, chemistry, biology).

Bavaria: Prüfungsordnung für das Lehramt an höheren Schulen. (Amtsblatt des Bayerischen Staatsministeriums für Unterricht und Kultus 5/1959), p. 84-87, (Physics, chemistry, biology).

After having passed the first State examination the cadet teachers receive pedagogical, psychological and didactical training in a two-year preparatory service under the guidance and supervision of experienced senior teachers. This finished they have to pass a second (the so-called pedagogical) examination and may go into teaching. The ministries of education regulate the preparatory service and the second examinations by special orders. For example:

Baden-Württemberg: Ordnung des Vorbereitungsdienstes und der Pädagogischen Prüfung für das Lehramt an Gymnasien in Baden-Württemberg vom 19 März 1959. (Amtsblatt des Kultusministeriums Baden-Württemberg 4/1959), p. 227-236.

Guides are also issued by ministries of education in respect of standards for school science laboratories. For example:

Baden-Württemberg: Richtlinien für die Einrichtung und Ausstattung von Fachräumen für Physik, Chemie, Biologie, Erdkunde und Mathematik. (Im Auftrag das Kultusministeriums von Baden-Württemberg herausgegeben von der Landesanstalt für Erziehung und Unterricht, Stuttgart).

There are no books devoted exclusively to the training of science teachers, but periodical articles frequently discuss present problems, especially the question of effective preparation of the academically trained junior teachers for their practical work in schools. Such periodicals are:

Der mathematische und naturwissenschaftliche Unterricht. (Deutscher Verein zur Förderung des mathematischen und naturwissenschaftlichen Unterrichts). Bonn, Ferdinand Dümmler-Verlag; Frankfurt, Hirschgraben-Verlag. (Monthly).

Die höhere Schule. (Deutscher Philologenverband). Düsseldorf, Pädagogischer Verlag Schwann. (Monthly).

Das Studienseminar. (Hans Lohmeyer ed.). Frankfurt, Berlin, Bonn, Verlag Moritz Diesterweg. (Twice a year).

Der Gymnasialunterricht. (Robert Ulshöfer ed.). Stuttgart, Ernst Klett Verlag. (Irregular, till now 4 items).

The teacher who must be both scientist and educator is expected to study the most recent developments in his field and to increase his knowledge. He should read the relevant scientific journals and books and attend the different courses offered by the ministries of education, teachers' associations and other bodies. Participation is not compulsory; the authorities trust the initiative of the teachers themselves. In some "Länder" there are special institutions which advise teachers and also offer courses. Such institutions are:

Landesanstalt für Physikunterricht, Stuttgart-Bad Cannstatt, Prafstr. 17.

Pädagogische Arbeitsstelle, Berlin-Schöneberg, Grunewaldstr. 4-6.

Pädagogische Arbeitsstelle, Bremen, Humboldtstr. 183.

Beratungsstelle für den naturwissenschaftlichen Unterricht, Hamburg 6, Felix-Dahnstr. 7.

Landesstelle für den naturwissenschaftlichen Unterricht, an den höheren Schulen von Nordrhein-Westfalen, Recklinghausen Hohenzollernstr. 484.

Naturwissenschaftliche Beratungsstelle des Landes Hessen, Frankfurt/Main.

A major part is played in the qualification of science teachers by the Deutscher Verein zur Förderung des mathematischen und naturwissenschaftlichen Unterrichts e. V., Hamburg 20, Eppendorfer Weg 186, which organizes courses for teachers and members of the teacher-training institutions.

A selected list of works on the teaching of science subjects follows:

PHYSICS

Angst, W.; Schatzmann, M. Physikalische Schulversuche. Zürich, Logos-Verlag, 1960. 219 p.

Brenneke; Wolski. (ed.) Gedanken zur Reform des Physikunterrichts. Beihefte für den physikalischen Unterricht. Braunschweig, Vieweg and Sohn. 144 p.

Friedrich. Handbuch der experimentellen Schulphysik. 8 vol. Köln, Aulis. Vol. I, 1961, 356 p.; vol. II, 1961. 320 p.

Gronau. Physikalisches Experimentierbuch. Braunschweig, Vieweg and Sohn, 1956. 260 p.

Hahn, K. Methodik des Physikunterrichts. Heidelberg, Quelle and Meyer, 1955. 297 p.

Hunger, E. Die Bildungsfunktion des Physikunterrichts. Braunschweig, Vieweg and Sohn, 1959. 75 p.

Physik-Versuche. (Gesammelt und bearbeitet von E. Brestchneider). Göttingen, Phywe AG.

Praxis-Schriftenreihe. Abteilung Physik. Köln, Aulis. Vol. I- , 1957-

Schröder, H. (ed.). Atomphysik in Versuchen. Ein methodischer Leitfaden für den Unterricht. Braunschweig, Vieweg and Sohn, 1959. 239 p.

Stutzer, H. 'Physik', Erziehung zum Menschen, Frankfurt, Diesterweg, 1954, p. 122-135.

CHEMISTRY

Arendt-Dörmer. Technik der Experimentalchemie. Heidelberg, Quelle and Meyer, 1954. 439 p.

Brandstätter. Chemische Schulversuche. Wien, Deuticke, 1950, 369 p.

Die Chemie in Versuchen. (Gesammelt und bearbeitet von W. Kintoff). Gottingen, Phywe AG.

Flörke. Methode und Praxis des chemischen Unterrichts. Heidelberg, Quelle and Meyer, 1951. 189 p.

_____. Arbeitsbuch für die chemischen Arbeitsgemeinschaften im Gruppenunterricht. Heidelberg, Quelle and Meyer. 62 p.

Hübner, W. 'Chemie', Erziehung zum Menschen, Frankfurt, Diesterweg, 1954, p. 136-149.

Kintoff-Wagner. Handbuch der Schulchemie. Technik-Methodik-Didaktik. Köln, Aulis, 1961. 440 p.

Lüthje/Böse (ed.). Schriftenreihe zur Chemie. Frankfurt/Main, Salle. Vol. I- , 1956- .

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Praxis-Schriftenreihe, Abteilung Biologie. Köln. Aulis, Vol. I - , 1959- .

HUNGARY

(Submitted by the National Commission for Unesco)

The term "secondary education" universally accepted in international pedagogic parlance does not exactly fit the institutions called "secondary schools" in Hungary. The term relates, in fact, to the teaching of certain subjects by specialized teachers at schools with a 7 or 8-year course for pupils aged from 10-11 to 17-19 years who have completed their studies at a primary school, with a 4-year course. In Hungary, however, the primary school, known as the "general school" (which is a unified type of school) has an 8-year course for children aged from 6 to 14. The lower cycle of this school corresponds to the primary school in the strict sense, while the upper cycle (also of 4 years' duration) provides instruction by specialized teachers in particular subjects. On completion of the 8th year at a primary school, pupils may enter one of the various types of secondary school. The present report covers the training of science teachers for classes of the upper cycle of primary schools, as well as for those of secondary schools.

Science teachers in Hungary are trained either at the pedagogical high schools (teacher-training colleges) or at science faculties. The former grant teachers' diplomas valid for primary schools (higher certificate), while the latter grant diplomas valid both for secondary schools and for the upper cycle at primary schools.

To obtain these diplomas, the candidates must complete the studies prescribed by the curriculum and obtain the prescribed pass marks in the examinations set.

The teacher-training course at the pedagogical high schools lasts four years, divided into eight semesters. The students have to choose three special subjects, two from among the

mathematics-physics, mathematics-chemistry and biology-geography groups, and a third which may, for example, be technical knowledge, agricultural knowledge, drawing, language of one of the national minorities, etc.

The period of study at the science faculties is five years. The students are required to choose two special subjects from among the following groups : mathematics-descriptive geometry, mathematics-physics, chemistry-physics, biology-chemistry and biology-geography.

In order to obtain a higher certificate or a teacher's diploma, the candidates must take the courses prescribed in the curriculum approved by the Ministry of Culture, and do practical work in laboratories and science study rooms and practice teaching as trainees at one of the schools designated for that purpose. They are also required to take the prescribed end-of-term examinations and (at certain intervals) major examinations (roughly equivalent to those for the French licence and agrégation) covering a considerable portion or even the whole of the special subjects chosen. The final examination is called the State examination for which presentation of a thesis is a prerequisite.

Workers wishing to obtain a higher certificate or a diploma can take the correspondence teaching courses offered by teacher-training colleges and science faculties. The choice of special subjects is limited (mathematics-physics, mathematics-biology and biology-geography at the teacher-training colleges and mathematics-descriptive geometry at the faculties), but the requirements which candidates have to meet are the same.

For teachers in service, refresher courses are organized at regular intervals by the Municipal Pedagogic Institute (Budapest 8, Horváth Mihálytér). These courses are compulsory : all primary and secondary school teachers have to take them for one year but have the right to choose the school year most convenient for them during a five-year period.

Two institutions - a secondary school and an upper primary school, both under the authority of the Pedagogic Institute - have been designated to give these refresher courses in Budapest. Schoolmasters wishing to improve their science teaching attend their colleagues' courses in small groups. The courses are followed by discussions and supplemented by lectures by the most qualified teaching specialists in Hungary.

INDONESIA

(Submitted by the National Commission for Unesco)

There are two levels in the secondary schools of Indonesia :

(a) the SLTP (Sekolah Landjutan Tingkat Pertama ; the primary or the lower level of three years' duration for general schools, and three to four years for some vocational schools).

(b) the SLTA (Sekolah Landjutan Tingka Atas ; the upper level, of three to four years' duration). (Note : some vocational secondary schools have seven school years).

The requirement for teaching in a general secondary school is completion of the course in one of the following four teacher-training schools :

A. the SGA (Sekolah Guru A ; upper level, six years after elementary school).

B. the PGSLP (Pendidikan Guru Sekolah Landjutan Pertama ; one year after SGA).

C. the BI Course (Kursus BI.) two to three years after SGA or other secondary schools of the upper level.

D. BII Course (Kursus BII), two years after the BI Course.

THE SEKOLAH GURU A

This institutions is primarily intended to produce qualified teachers for the elementary schools, but owing to the shortage of secondary school teachers until July 1956 graduates of this school were appointed as secondary school teachers. Since August 1956 only the highest ranking graduates have been permitted to teach in secondary schools, and in some provinces SGA graduates are appointed only as elementary school teachers.

The students study 22 subjects, so that as they are able to teach any subject, including science, in secondary schools, they may either select science as the subject they wish to teach or the principal of their school may request them to teach it.

THE PENDIDIKAN GURU SEKOLAH LANDJUTAN PERTAMA

Offers temporarily a basic training course to prepare primary level teachers for teaching in secondary schools. Most of the students have SGA certificates and are pursuing their studies on scholarships (tugas beladjar). SMA (Sekolah Menengah Atas, Senior High School) graduates may enter only the physics branch or the mathematics branch ; they are excluded from the seven other branches (Indonesian language, English, history, geography, biology, drawing and pedagogy). From its establishment in August 1952 until July 1958 the course was of one year's duration ; it then became a 20 months course, held in the same building and taught mainly by the same staff as the SMA (Senior High School).

THE KURSUS BI AND KURSUS BII

These two institutions are closely associated and offer courses in 16 branches of study. There are

four branches of science, i.e. : physics, biology, chemistry and science teaching.

The graduates of both institutions, since their establishment in 1950, have served in SGA, SMA and other upper level secondary schools. In September 1961, these institutions will be liquidated. The training of science teachers for the upper level secondary school will then be the sole responsibility of the FKIP (Fakultan Keguruan dan Ilmu Pendidikan or the Faculty of Education) into which the Kursus 2 BI/BII will be integrated.

No reliable statistics on science teachers for secondary schools are available at present, but at a rough estimate about 10% of science teachers of the lower or primary level and 5% of those of the upper level, have had special training and are considered to be qualified.

The organization and training of science teachers received special attention with the establishment in 1957 of the Balai Pendidikan Pengetahuan Alam (Science Teaching Centre). This national institution at Bandung, sponsored by the Department of General Education, is responsible for the training of science teachers, preparation of teachers' manuals and textbooks, preparation of simple laboratory equipment, and for reforms in all aspects of science teaching.

In 1952, under the Technical Assistance programme, Unesco provided an expert who organized a series of in-service training courses lasting for 3 to 8 weeks. As a result of this project, the Science Teaching Centre was developed as a permanent institution, it now has a regular training course of about three years, and special training is provided for the staff of the provincial science teaching centres, which train teachers and supervisors for schools in the respective provinces. The Colombo Plan has provided laboratory equipment and other teaching aids which have been distributed to provincial centres and schools. The last expert sent by Unesco to the Centre completed his assignment in April 1961.

ISRAEL

(Submitted by the National Commission for Unesco)

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A guide for teachers of science, geography and nature study.

Shapira, M. Hora-at ha-Physica be-Veit ha-Sefer ha-Tikhon. (Physics teaching in secondary schools).

JAPAN

(Submitted by the National Commission for Unesco)

There is no special legislative document concerning the training of science teachers. Each university providing courses leading to qualification for science teacher certificates draws up its own curriculum, taking into consideration the course of study for both lower and upper secondary schools and the educational personnel certification law. As for qualifications obtainable through in-service training, provisions are made for these in Article 6 of the above-mentioned law and in Articles 11, 12 and 13 of the enforcement regulations of that law.

Ministry of Education. Kyōin shokuin Menkyohō oyobi Dōhōkankei Hōreishu. Tokyo, 1956.
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_____. Chugakko Rika Shidōsho. Tokyo, 1959.
Teachers' manual for science teaching at the lower secondary schools.

_____. Kōtōgakko Gakushu Shidō Yoryokaisetsu Rikahen. Tokyo, 1961.
Commentary on the course of study for upper secondary schools (science).

KOREA

(Submitted by the National Commission for Unesco)

In Korea, there is no college level institute exclusively for the training of science teachers for secondary schools. General training is given in the science departments of colleges and universities; and, in order to qualify as secondary school science teachers, students must also take certain courses in education in addition to the scientific subjects. Science teachers are also trained in the education colleges.

According to the Education Law promulgated on 31 December 1949 and amended by Law nos. 118, 178 and 228:

(a) those who have finished science courses at the science departments of education colleges are entitled to the 2nd grade regular science teacher certificate;

(b) those who have finished science courses at the industrial colleges are entitled to the 2nd grade regular teacher certificate;

(c) those who have finished science courses at the science departments of ordinary colleges and universities are entitled to the assistant science teacher certificate;

(d) those who have passed an examination for qualification of secondary science teachers are entitled to the assistant science teacher certificate.

LEGISLATIVE AND ADMINISTRATIVE DOCUMENTS

Although there are no special laws or ordinances concerning the training of science teachers for secondary schools in this country, relevant portions of general documents are as follows:

(a) Syllabuses of science teaching:
   1. Items on science curriculum organization for middle schools: Education Ministry Ordinance no. 45, promulgated on 1 August 1955.
   2. Items on science curriculum organization for high schools and normal schools; Education Ministry Ordinance no. 46, promulgated on 1 August 1955;
   3. Standard of science subject hour allocation for primary, middle, high and normal schools; Education Ministry Ordinance no. 35, promulgated on 20 April 1954.

(b) Qualification: Educational public officials law, chapter 2, "Qualification and certificate".

(c) Establishment of standards for provision and maintenance of laboratories, special libraries, and classrooms for science teaching:
   Standard for the establishment of colleges and universities, chapter 3, "Facility standards";
   Presidential Ordinance no. 1063, promulgated on 4 April 1955.

(d) In respect of in-service training, specifications are given for the qualifying examination for educational public officials in chapter 5 "Educational training course"; Education Ministry Ordinance no. 39, promulgated on 11 November 1954.

TEACHERS' MANUALS AND GUIDE BOOKS

A series of interesting scientific experiments for middle schools
This series covers physics, biology and chemistry for all grades.

GRAND DUCHY OF LUXEMBOURG

(Submitted by the Ministry of Education)

The legislative and administrative documents governing the syllabuses and curricula for science teaching are contained in the publication "Horaires et Programmes"; those specifying the qualifications

and requirements of science teachers are contained in the Ministry of Education publication on the "Conferment of degrees" ("Collation des Grades").

Once he has qualified by passing the required examinations, the science teacher receives his final appointment if a total of 22 lessons a week to be taught can be found for him in a secondary school.

Total State expenditure for certain items relating to secondary science teaching (for 1960) is listed below :

	Belgian francs
physics rooms	173,000
chemistry rooms	139,000
biology rooms	70,000
microscopy rooms	10,000
psychology rooms	4,000
mathematics courses	18,000
geography courses	18,000
geology courses	3,000
mineralogy courses	3,000
upkeep of botanical gardens	2,000
gramophone and radio services	12,000
school cinema and projection services	23,000
scientific, literary and historical excursions for pupils	23,000
instruments for physics rooms	250,000
instruments for chemistry rooms	150,000
collections and instruments for biology rooms	395,000
wall maps for history and geography courses	10,000
apparatus for projection services	12,000

Science teachers are allowed to improve their qualifications while in service and acquire certain foreign university degrees, but only on their own initiative.

Ministère de l'éducation nationale. Collation des grades. Règlementation concernant les stages. Luxembourg, Ch. Munshausen, 1950.

_____. Horaires et programmes de l'enseignement secondaire et supérieur et de l'Institut pédagogique. Esch s/Alzette, Ney-Eicher. Yearbook.

MONACO

(Submitted by the National Commission for Unesco)

There are no special provisions governing the training of science teachers for secondary schools. Science teachers in Monaco, whether of French or Monégasque nationality, receive their training at French universities or specialized institutions.

NETHERLANDS

(Submitted by the National Commission for Unesco)

Teachers are trained both at the universities and in non-university institutions. Examination programmes for the secondary certificates in physics and chemistry were included in the Royal Decree of 14.7.1958, Statute Book 334, an extract of which is given below :

SECTION 1

1. The examination for the A Certificate qualifying to teach physics and chemistry in secondary schools, referred to in section 73, paragraph 1 of the Secondary Education Act, comprises :
   (a) knowledge of elementary physics and chemistry ;
   (b) knowledge of some special subjects in the field of physics, at the choice of the candidate, subject to the approval of the examining board ;
   (c) knowledge of some special subjects in the field of chemistry, at the choice of the candidate, subject to the approval of the examining board ;
   (d) knowledge of those subjects in the field of mathematics which are indispensable for the practice of physics and chemistry.
2. The candidate must also give proof of adequate proficiency in carrying out experiments in physics and chemistry.

SECTION 2

The examination, referred to in section 1, in subjects (b), (c) and (d) is an oral one ; for subject (a) it may be both oral and written.

SECTION 3

1. The examination for the B Certificate qualifying to teach physics in secondary schools, as referred to in Section 73, paragraphs 2 and 3 of the Secondary Education Act, comprises :
   (1) knowledge of classical mechanics ;
   (2) knowledge of quantum mechanics and some of its applications ;
   (3) knowledge of the science of electricity and of the theory of relativity ;
   (4) knowledge of two of the following subjects, at the choice of the candidate :
   a. statistical mechanics, b. nuclear physics, c. spectroscopy, d. physics of low temperatures, e. science of magnetism, f. science of sound, g. one or more selected topics from the history or the methodology of physics, subject to the approval of the examining board, h. another topic, subject to the approval of the examining board.
2. At the examination note will be taken of the candidate's insight into the nature and methodology of physical research.

SECTION 4

1. The examination referred to in section 3, shall be held orally.
2. The candidate must give proof of adequate proficiency in carrying out experiments.

SECTION 5

1. The examination for the B Certificate qualifying to teach chemistry in secondary schools, referred to in section 73, paragraph 2 of the Secondary Education Act, comprises:
   1. the essentials of physical chemistry, including thermo-dynamics, inorganic and organic chemistry, including the fundamental aspects of bio-chemistry;
   2. knowledge of the theory of chemical fixation and the science of reaction mechanisms;
   3. knowledge of two of the following subjects, at the choice of the candidate:
   (a) an important class of fixations; (b) a fundamental methodology; (c) a theoretical methodology; (d) one of the branches of chemistry or those branches of physics which are connected with chemistry; (e) one or more selected topics from the history of the methodology of chemistry, subject to the approval of the examining board; (f) some other topic, subject to the approval of the examining board.
2. At the examination note will be taken of the candidate's insight into the nature and methodology of chemical scientific research.

SECTION 6

1. The examination referred to in section 5 shall be held orally.
2. The candidate should give proof of adequate proficiency in carrying out experiments.

The examination programme for the Certificate qualifying to teach botany and zoology in secondary schools has been laid down by Royal Decree of 2.6.1958, Statute Book 271.

This programme is given in the following sections 1 - 3.

SECTION 1

The examination for the Certificate qualifying to teach botany and zoology in secondary schools, as referred to in section 75 of the Secondary Education Act, comprises an oral and a practical part.

SECTION 2

1. The requirements for the oral part of the examination are as follows:
   1. knowledge of general biology, particularly genetics;
   2. knowledge of general and special botany;
   3. knowledge of general and special zoology;
   4. knowledge of the structure and vital functions of man;
   5. knowledge of the chief species of the flora and fauna of the Netherlands.
2. For the examination in subjects 1 through 4 inclusive, candidates must give proof of having adequate knowledge of the elements of physics and chemistry which are required for a sound understanding of those subjects.

SECTION 3

In the practical part of the examination the candidate must prove his proficiency in carrying out observations and research in the field of biology.

In addition to the aforementioned secondary certificates the teacher should hold a certificate of pedagogic and didactic preparation for that subject; for this he must successfully pass the appropriate examination (section 68 of the Secondary Education Act). Conditions for admission are laid down by Royal Decree of 19.3.1960, Statute Book 132.

The University examinations (in the framework of Higher Education) have been laid down in the Academic Statute (1921). Chapter IV of the Statute describes the examinations for the doctorate in mathematics and physics, in paragraphs 28-41:

Para. 28. The Bachelor's examination comprises one of the following groups of subjects:
(a) mathematics and physics, combined with astronomy;
(b) mathematics and astronomy, combined with physics;
(c) astronomy and physics, combined with mathematics;
(d) physics and mathematics, combined with chemistry;
(e) physics and chemistry, combined with mathematics;
(f) chemistry in combination with physics, mathematics and mineralogy;
(g) chemistry combined with physics, botany and mineralogy;
(h) geology and mineralogy combined with zoology, chemistry and botany;
(i) geology and mineralogy combined with zoology, chemistry and physics;
(j) mineralogy and geology combined with physics, chemistry and mathematics;
(k) botany and zoology combined with physics, chemistry and geology;
(l) chemistry and zoology combined with physics.
(This paragraph has been amended thus by decree of 23 August 1930, S. 371).

Para. 29. The Bachelor's examinations mentioned under (a), (b) and (c) give admission to a final examination for a degree with mathematics as the principal subject; those mentioned under (c), (b) and (a), to a final examination for a degree with

astronomy as the principal subject; those mentioned under (d), (e), (a), (c) and (b) to a final examination for a degree with physics as the principal subject; those mentioned under (e), (f), (g) and (l) to a final examination for a degree with chemistry as the chief subject; those mentioned under (h), (i) and (j) to a final examination for a degree with geology as the principal subject; that mentioned under (k) to a final examination for a degree with biology as the principal subject; those mentioned under (l), (g) and (k) to a final examination for a degree with pharmacy as the principal subject.

All examinations for a Bachelor's degree referred to in para. 28 and the Bachelor's examination referred to in para. 81 bis give admission to a final examination for a degree in the faculty of mathematics and physics, with philosophy as the principal subject. (After having been amended by decree of 16 June 1928, S. 211, of 23 August 1930, S. 371, and of 21 November 1945, this paragraph has thus been laid down by decree of 13 December 1952, S. 635).

Para. 30. (Lapsed by Decree of 13 December 1952, S. 635).

Para. 31. The final examination for a degree comprises one principal subject and two subsidiaries, as laid down in paras. 32 up to and including 37.

Para. 32. The chief subject is selected by the candidate from the following list: mathematics, astronomy, physics, chemistry, biology, geography, pharmacy, philosophy (this paragraph was amended by decree of 13 December 1952, S. 635).

Para. 33. Other equivalent subjects may, as soon as the need presents itself, be added to the list of para. 32, at the suggestion of the faculty concerned, by supplementing this decree.

Para. 34. It is within the competence of the faculty to take account, at the examination for the final degree, of the candidate's preference for one or more specific parts of the principal subject selected by him; the faculty shall define these parts. If, in the opinion of the faculty, the scope of the part or the parts thus selected renders it necessary to restrict the subject matter of the examination, it has the competence to reduce to one the number of subsidiary subjects.

Para. 35. As subsidiary subjects the candidate may select, subject to the approval of the faculty, those referred to in para. 32, or parts thereof, or subjects or parts of subjects of one of the faculties, or combined faculties, referred to in section 76 of the Higher Education Act. (This paragraph has thus been laid down by decree of 13 December 1952, S. 635, after having been amended by the decrees of 23 August 1930, S. 371 and of 16 February 1933, S. 51).

In virtue of section 17 bis, para. 2 of the Academic Statute, the graduate should give evidence of sufficient pedagogical and didactic training. This involves attending courses for one year in pedagogy, educational psychology and general didactics, and also courses in teaching method of the subject or subjects for which teaching qualifications are demanded.

If the candidate cannot give evidence of such training, he must sit an examination. In the State Universities of Utrecht and Groningen pedagogics and vocational didactics may be selected as a second subsidiary subject, for a period of study of six months.

General provisions for the building and equipment of classrooms for grammar schools and modern grammar schools are laid down by decree of the Minister of Education, Arts and Sciences, dated 2 October 1923, no. 8868, Secondary Education Department. Under Section 6 the schools should comprise at least two special classrooms, one for chemistry, physics and natural history, and one for freehand drawing and possibly for linear design.

With the approval of the Minister of Education, Arts and Sciences, a separate classroom may be equipped for each of the subjects mentioned. If the school building is designed as a modern grammar school with a five-year course, a grammar school or lyceum, a classroom for practical experiments in chemistry is desirable. There are as yet no official regulations for the building and equipment of classrooms for these subjects in the Netherlands.

University institutions and teachers' organizations arrange refresher courses for teachers which attract much interest; these are usually holiday or evening courses. A study is being made of the possibility of incorporating them in the teachers' training courses.

The Association of Biology Teachers arranges, in conjunction with each of the Universities in turn, holiday courses (usually in the Christmas holidays) and evening courses (4-8 evenings a year). The organization of these has been assigned to Dr. J. C. v. d. Steen, lecturer of didactics in the State Universities of Utrecht and Leiden. However, in view of the enormous expansion in the field of biology, such courses are quite insufficient, and teachers need also to attend practical courses, for instance, on the genetics and physiology of plants, animals and man.

Reinders, E. Didactica botanica. Groningen-Djakarta, J. B. Wolters, 1954.

Rekveld, J.; van der Steen, J. C.; de Tombe, W. J. Natuurkennis voor de lagere school; didactisch-methodische handleiding voor de onderwijzer. Groningen-Djakarta, J. B. Wolters, 1955.

Stellwag, H. W. F. Begane wegen en onbetreden paden. Groningen, J. B. Wolters.

_____. Viaticum Didacticum. Groningen, J. B. Wolters.

Stellwag, H. W. F.; van de Griend, P. C. De leraarsopleiding: knelpunt of raakvlak tussen Universiteit en V. H. M. O., een vergelijkende studie over de situatie in Nederland en elders. Groningen, J. B. Wolters, 1959.

NORWAY

(Submitted by the National Commission for Unesco)

In Norway, science is not taught as one subject except in the first years in the primary school, where it is called "Learning about the home", giving the children an introduction to the world surrounding them. From the fourth grade on, a subject called "Natural science" comprising biology and health, physics and chemistry is taught. Astronomy and geology are taught in connexion with geography.

In the secondary schools ("realskole" and "gymnas"), the following subjects are taught individually: biology, physiology and health, physics and chemistry.

The teachers of natural sciences in the secondary schools must have a degree in natural science from one of the Norwegian universities. There are two degrees, one requiring four years, and qualifying for the position of "adjunkt" (comparable to the B. Sc. degree), and one taking 6 years, qualifying for the position of "lektor" (comparable to the M. Sc. degree). Both degrees may be taken in three or four of the natural sciences, but more often mathematics and two or three of the natural sciences are covered. For the higher degree one of the subjects is selected as a major subject.

As a rule the secondary schools have their own laboratories and lecture theatres for each of the following subjects: biology, physics and chemistry. The Department of Church and Education has prepared plans for these rooms and issued directions on their number in relation to the size of the school. Schools usually have separate libraries for teachers and students.

Courses in natural science are given during the summer vacation for teachers in primary and secondary schools. There is no obligation to participate, but many teachers do so.

Lindstad, O. Laerebok i kjemi for realskole og gymnas. Oslo, Nationaltrykkeriet, 1949. 149 p.

_____. Fysikk og kjemi. Oslo, Hestholms boktrykkeri, 1950. 129 p.

Naturen. Bergen University. [Periodical].

PAKISTAN

(Submitted by the Ministry of Education and Scientific Research)

The relevant official documents are as follows:

Central Government Teachers' Training College. Prospectus and courses of studies for the degrees of Master of Education and Bachelor of Education. Karachi, Government of Pakistan Press, 1960.

Rules for conducting the examination for the Certificate of Teaching (C. T.). Karachi, Director of Education, 1960, processed.

Curriculum and syllabus for the Certificate of Teaching final examinations. Karachi, Director of Education, 1960, processed.

Board of Secondary Education, Karachi. List of minimum equipment for the teaching of general science, physics, chemistry, biology, health science, domestic science, arts and crafts, and physical education. Karachi, the Board, [n. d.]. 32 p.

Owing to the dearth of trained science teachers, especially in the non-government recognized schools, the teaching of science subjects has often to be entrusted to untrained staff. Graduates in science usually teach the top classes (IX and X) of the secondary school; and those with lower qualifications (intermediate degree or even matriculation) teach the earlier classes.

In training colleges and training schools which have well equipped science laboratories, general science, physics and chemistry, biology, etc., are the subjects generally chosen for specialization by pupil teachers who have the basic academic qualification. They receive the necessary theoretical and practical training, as set out in the curricula and syllabuses, through lectures, group discussion, demonstration practical work, and classroom teaching practice under the supervision of their teachers and lecturers.

Science graduates do not often take up a teaching career, however, because they are offered higher salaries and better prospects elsewhere. In schools they receive the same pay as teachers of other subjects. In view of the shortage, untrained science graduates are now being offered the same salaries, but they rarely remain in their posts. Understandably the continual change of science teachers in schools has a most detrimental effect on the teaching of the subject.

Detailed courses of study are prescribed for the various classes and also the textbooks to be used. In regard to methods, the trained teacher is guided by his professional training, and if he is untrained, by his own resources and ingenuity. Reference books on teaching science are rarely consulted and the teaching of science is all too often neglected.

Since general science is a compulsory subject in all secondary school classes, all schools have

a science laboratory equipped with apparatus sufficient for demonstration experiments, although not sufficient for the students to do any practical work themselves.

There is no arrangement for the in-service training of science teachers at present nor is there any provision for bringing out manuals, guides, etc., for science teachers to help them to improve their teaching efficiency.

SUDAN

(Submitted by the National Commission for Unesco)

There is as yet no training centre for secondary school science teachers; the present staff is drawn from two main sources:

1. Expatriates. These are by far the majority. They are qualified, trained teachers, who usually have had some experience in their countries of origin, and are drawn mostly from the United Arab Republic, the United Kingdom, and to a lesser extent from India.
2. A very small number of Khartoum University graduates take up teaching jobs in school. They may be holders of degrees or, until recently, diplomas. Sometimes persons who have failed are employed. All these teachers are untrained, and they receive guidance from older masters and, possibly, the visiting inspector.

Syllabuses for science are prepared by the science committee of Cambridge University, U. K. The science panel of the Sudan, made up of representatives of science teachers in schools may, at its annual meeting, suggest amendments to the Sudan Examinations Council. This body presents the suggestions to Cambridge for approval.

No official documents are issued on methods or programmes. In addition to the information given in the normal library books, teachers may receive advice from the inspector, who also advises on standards for laboratories and special libraries.

Sudan Examinations Council. Regulations for the joint examination for the Sudan School Certificate and the General Certificate of Education. Khartoum. Annual.

SWEDEN

(Submitted by the National Commission for Unesco)

SYLLABUSES AND PROGRAMMES OF SCIENCE TEACHING

Programmes for the various types of school are:

Kungl. Skolöverstyrelsen. Timplaner och huvudmoment vid försöksverksamhet med nioårig enhetsskola. Stockholm, Svenska Bokförlaget Norstedts, 1955. (Supplement 1959).

_____. Kursplaner och metodiska anvisningar för realskolan. Programmes contained in Aktuellt från skolöverstyrelsen, 1958: 16 and supplement to methodical instructions in Aktuellt från skolöverstyrelsen, 1956: 23-24, Stockholm.

_____. 'Normalundervisningsplaner för praktiska kommunala realskolor', Aktuellt från skolöverstyrelsen, 1958: 15, Stockholm.

_____. 'Normalundervisningsplaner för kommunala flickskolor', Aktuellt från skolöverstyrelsen, 1958: 10, Stockholm.

_____. 'Metodiska anvisningar för kommunala flickskolor', Aktuellt från skolöverstyrelsen, 1958: 25-26, Stockholm.

_____. Kursplaner och metodiska anvisningar för gymnasiet. (Skolöverstyrelsens skriftserie 36). Stockholm, 1960.

QUALIFICATIONS AND CONDITIONS FOR SCIENCE TEACHERS

These are to be found in the relevant regulations for different types of school. The curricula leading to teaching certificates are contained in yearly handbooks published by the universities, and are not cited here. The following are among the main regulations:

Läroverksstadgan, paras. 177-180, 182-185. 1959.

Aktuellt från skolöverstyrelsen, 1959, para. 8.

Stadgan för högre kommunala skolor, paras. 59-61.

Stadgan för statsunderstodda privatläroverk, paras. 26 and 28.

Folkskolestadgan, paras. 167, 173-175. 1958.

Statsliggaren, 1960/61.

STANDARDS FOR CLASSROOMS AND MATERIALS

These are contained in:

Skolbyggnader. (Kungl. Skolöverstyrelsens skriftserie 20). Stockholm.

Typritningar över skollokaler. Stockholm, Skolöverstyrelsens förlagsexpedition.

Martenelförteckningar. Stockholm, Skolöverstyrelsens förlagsexpedition (in press).

TEACHERS' MANUALS AND GUIDES

Most of the curricula listed above give guidance on teaching. A journal devoted to the physical sciences and mathematics is also published :

Elementa : tidskrift för matematik, fysik och kemi, Stockholm.

UNITED ARAB REPUBLIC
(Submitted by the Documentation and Research Centre for Education)

Cairo. Ein Shams University. Faculty of Education. Dalīl al-kullīyah (The faculty guide). Cairo, 1959, p. 37-38, 72, 102 and 140.

Egyptian Region. Laws, Statutes ... etc. al-Lā'ihah al-asāsiyah lil-kullīyāt wa-al-mā'ahid al-'ālīyah al-tābi'ah li-Wazārat al-Tarbiyah wa-al-Ta'līm wa-al-lawā'iḥ al-dākhilīyah lahā (Basic regulations of faculties and higher institutes of the Ministry of Education). Cairo, Ministry of Education, Department of Legal Affairs, [n.d.] p. 287-309.

_____. _____. al-Qānūn raqam 211 li-sanat 1953 bi-sh'an tanẓīm al-ta'līm al-thānawī wa-al-qawānīn al-mu'addilah lahu wa-al-qarārāt al wazārīyah al-munaffidhah li-ahkāmih. (Law no. 211 of 1953 concerning the organization of secondary education, its amendments and executive ministerial decrees). Cairo, Ministry of Education, Department of Legal Affairs, [n.d.]. 88 p.

_____. Ministry of Education. In-service Training Department. Dalīl barāmij al tadrīb al-shitwīyah, 1960. (Guide to winter training courses, 1960). Cairo, [1960], p. 7-8.

_____. _____. _____. Dalīl barāmij al-ta'hīl al-fannī wa-al-tarbawī ma'a al-kullīyāt al-jāmi'īyah. (Guide to technical and educational qualifying programmes, jointly with university faculties). Cairo, [n.d.], p. 24-25.

_____. _____. _____. al-tadrīb fī maydān al-ta'līm al-'ām, li-hay'āt al-tadrīs fī al-ta'līm al-ibtidā'ī wa-al-i'dādī wa-al-thānawī. (Training in general education, for teaching staff for elementary, preparatory and secondary schools). Cairo, 1957, p. 16-21.

_____. _____. _____. al-taqrīr al-sanawī (Annual report.) Cairo, 1958, p. 30.

_____. _____. Manāhij al-dirāsah al-muwahhadah lil-marḥalah al-thānawīyah al'āmah, al-ssaf al-awwal. 1960/1961. (The unified curricula for general secondary schools, first grade, 1960/1961.) Cairo, 1960, p. 68-89.

Egyptian Region. Laws, statutes ... etc. al-lā'ihah al-tanfidhīyah li-qānūn tanzīm al-jāmi'āt bi-al-Jumūhurīyah al-'Arabīyah al-Muttuhidah. (Executive regulations of the law governing universities in the United Arab Republic). Cairo, Higher Council for Universities, 1959, p. 152-164, 292-301, 391-401, 548-559, 628-630, 639-651.

UNITED KINGDOM
(Submitted by the National Commission for Unesco)

ENGLAND AND WALES - LEGISLATIVE AND ADMINISTRATIVE DOCUMENTS

Syllabuses and programmes of science

There are no State curricula or syllabuses.

Regulations and syllabuses issued periodically by various approved Examination Bodies for the General Certificate of Education (ordinary, advanced and scholarship levels) indicate the levels of attainment expected. A few typical examination bodies are :

University of London School Examinations Council, Senate House, London, W. C. 1.

Joint Matriculation Board (Universities of Manchester, Liverpool, Leeds, Sheffield and Birmingham), 315 Oxford Road, Manchester 13.

Southern Universities Joint Board for School Examinations (Universities of Bristol, Exeter, Reading and Southampton) 22 Berkeley Square, Bristol 8.

University of Cambridge Local Examination Syndicate, Syndicate Buildings, Cambridge.

Oxford Local Examinations, 12 Merton Street, Oxford.

Oxford and Cambridge School Examination Board, 74 High Street, Oxford, and 10 Trumpington Street, Cambridge.

Associated Examining Board, 31 Brechin Place, South Kensington, London, S. W. 7.

Welsh Joint Education Committee, 30 Cathedral Road, Cardiff.

University of Durham Matriculation and School Examination Board, 8 Sydenham Terrace, Newcastle-upon-Tyne.

Qualifications and conditions for science teachers

Pamphlets containing regulations on the training of teachers are periodically issued by the Ministry of Education.

Ministry of Education. Science in secondary schools. London, H. M. S. O., 1960. 164 p.

Chapter 18 deals specially with the teaching of science.

_____. Becoming a teacher. London, H. M. S. O., 1955. 14 p.

Ministry of Education. The supply and training of teachers for technical colleges : report of a special committee. London, H. M. S. O. 67 p.

_____. The training of teachers ; suggestions for a 3-year training college course. London, H. M. S. O. 1957, 22 p. (Pamphlet no. 34).

Association of Teachers in Colleges and Departments of Education. Handbook on training for teaching. London, Methuen, 1959. 467 p.
This book lists Training Colleges which have science as a special subject.

Classrooms, laboratories and special libraries

Ministry of Education. Science in secondary schools. London, H. M. S. O. , 1960. 164 p.
Chapter 17 is devoted to suggestions for the design of laboratories.

Building Bulletin. London, H. M. S. O. No. 2. 'Secondary schools', with supplement on 'New Secondary Schools', 1957 ; no. 8 'Development projects', 1957 ; no. 16 'Development projects', 1958 ; no. 17 'Development projects', 1960.

British Standards Institute. Recommendations on laboratory furniture and fittings, BS 3202, 1959. London, W. 1.

The Industrial Fund for the Advancement of Scientific Education in Schools. The planning of school laboratories and apparatus brochure. London W. 1.

Holt, C. ; Tapper, E. W. ; Dyball, R. H. The design and equipment of science laboratories. London, Councils and Education Press, 1960. 30 p.

Science Masters' Association. Provision and maintenance of laboratories in grammar schools (1959). Results of a questionnaire issued in 1959. London, John Murray, 1960. 16 p.

Royal Institute of British Architects. Design of teaching laboratories in universities and colleges of advanced technology. Report of a symposium... London, 1958. 31 p.

Training of science teachers

From time to time, the Ministry of Education organizes short courses and also supplementary special courses for the benefit of teachers ; participation is voluntary.

Oxford University Institute of Education, in co-operation with the Science Masters' Association. Science as a general study in the sixth form : report of a Conference of Science Teachers held at Oxford in July 1959. Oxford. Oxford University Institute of Education, 1960. 88 p.
This report has a general bearing on the question of staff in schools. Ministry of Education. Ages 15 to 18 : Report of the Central Advisory Council for Education - England. Vol. I Report. (Crowther Report). London, H. M. S. O. , 1959. 519 p.

Advisory Council on Scientific Policy. Annual Report 1959-1960. Command 1167. London, H. M. S. O. 32 p.

British Association for the Advancement of Science. The complete scientist. London, Oxford University Press, 1961. 162 p.
An inquiry into the problem of achieving breadth in the education at schools and university of scientists, engineers and other technologists. Report of the Leverhulme Study Group, directed by Sir Patrick Linstead.

Manuals and guides

Ministry of Education. Science in secondary schools. Pamphlet no. 38. London, H. M. S. O. , 1960. 164 p.

Incorporated Association of Assistant Masters in Secondary Schools and the Science Masters Association. The teaching of science in secondary schools, revised edition. London, John Murray, 1958. 274 p.

Laybourn, K. ; Bailey, C. H. Teaching science to the ordinary pupil. London, University of London Press, 1957. 415 p.

Science Masters' Association. Secondary modern science teaching : a report on the teaching of science in secondary modern schools. Parts I and II. London, John Murray, 1953 and 1957. 2 v.

Science Masters' Association and the Association of Women Science Teachers. Science and education. London, John Murray, 1961. 12 p.
There are three sections devoted to : Biology for grammar schools, Chemistry for grammar schools and Physics for grammar schools.

Science Teaching Techniques. Vols. I-VII : 1952-1959 (in progress). London, John Murray.
Published for the Association of Teachers in Colleges and Departments of Education, the Association of Women Science Teachers, the London Association of Science Teachers and the Science Masters' Association.
These books give practical suggestions to the teacher, but they are not manuals designed to accompany a particular textbook.

Periodicals

School Science Review - Journal of the Science Masters' Association and the Association of Women Science Teachers. Three issues a year. London, John Murray.

Science Club - alternate months. London, Junior Club Publications Ltd.

Science Teacher (a Science Club publication). London, Junior Club Publications Ltd.

NORTHERN IRELAND

The regulations and syllabuses are determined and defined by the various universities which issue rules and programmes. The regulations and syllabuses of training colleges have special chapters on the training of science teachers. There are no special documentary materials.

SCOTLAND

Syllabuses and programmes of science

Education Department. Junior secondary education. 22 p. and Science in secondary schools. 12 p. London, H. M. S. O., 1955 and 1959.

The above publications bring together the experience of teachers and the Scottish Education Department in an endeavour to show the best method of teaching science. They state the aims of the science teacher and contain suggestions about content, method and courses.

Education Department. Report on the teaching of science in secondary schools. London, H. M. S. O., 1957. 13 p.

A review of the present position with some suggestions about content and method, and comments on staffing, accommodation and equipment.

Scottish Education Department Circular 30, an annual publication, and Scottish Certificate of Education - Syllabuses and Specimen Question Papers - Science (Chemistry, Physics, Botany, Zoology, Biology) Ordinary Grade. London, H. M. S. O. 1959.

These are the syllabuses for examinations in science which are taken throughout Scotland and towards which senior secondary teachers work.

Qualifications and conditions for science teachers

Education Department. The regulations for the preliminary education, training and certification of teachers for various grades of schools (Scotland). London, H. M. S. O., 1931. 20 p.

There are subsequent amendments and the latest is:

Training of teachers (Scotland) (Amendment no. 9). Provisional regulations, 1959. London, H. M. S. O., 1959, 2 p.

The teachers' salaries (Scotland) regulations, 1959. London, H. M. S. O. 63 p.

Regulations establishing salaries for teachers.

The schools Scotland Code, 1956. London, H. M. S. O. 32 p.

The code of regulations relate to the conduct of schools and to the education to be provided therein.

Classrooms, laboratories and special libraries

The school premises (Standards and requirements) regulations, 1959, and 1961. London, H. M. S. O.

These regulations control the minimum areas, ceiling heights and storage space permitted in schools.

UNITED STATES OF AMERICA
(Submitted by the U.S. Office of Education)

The bibliography of selected references which follows was prepared to provide help to those planning and setting up secondary school science programmes in countries outside the continental United States. It was not considered advisable to include a large number of references. Rather, an attempt was made to limit this listing to those most pertinent to the problem. Certain references were not included because they have been replaced by others which are more recent; others were omitted because of their limited application.

Section one of the bibliography lists books containing specific suggestions for classroom teaching. Section two, containing more general references, will provide a background and philosophy for developing new programmes and revising old ones. The third section is devoted to recent major curriculum studies in biology, chemistry, and physics. Bibliographies of trade books for students and teachers, textbooks, films, and tests are found in still another section. Biology, chemistry, and physics courses on film are listed in another section. The final section provides references on facilities and equipment for teaching secondary school science.

TRAINING SCIENCE TEACHERS FOR SECONDARY SCHOOLS

Ashbaugh, Byron ; Beuschlein, Muriel. Things to do in science and conservation. Danville, Ill., The Interstate Printers and Publishers, Inc., 1960. 163 p.

The material in this book is not intended for a specific age level or subject in the curriculum. Each chapter presents basic conservation concepts related to a particular resource, activities for developing these concepts, projects for children to do, questions for further thought, and a bibliography of reference books. Part I deals with conservation of natural resources; and Part II with man-developed resources - electricity, synthetics, and nuclear energy.

Brandwein, Paul F.; Watson, Fletcher, G.; Blackwood, Paul E. Teaching high school science: A book of methods. New York, N.Y., Harcourt, Brace and Company, Inc., 1958. 568 p.

This book, with Teaching high school science: A source book for the biological sciences and Teaching high school science: A source book for the physical sciences, is intended to be a teacher's vade mecum. It includes chapters on teaching science-prone and science-shy students, the content and objectives of elementary and secondary school science courses, evaluation, science equipment and facilities, textbooks, and methods of curriculum-planning.

Burnett, R. Will. Teaching science in the secondary school. New York, N.Y., Rinehart and Company, Inc., 1957. 382 p.

The aim is to develop both theoretical insight and practical knowledge and skill in science teaching and to outline means for nurturing science talent. Part I presents basic problems with which the teacher is faced. Part II analyses these problems and emphasizes the application of theory and research to them. Part III is composed of articles by experienced teachers to illustrate the application of these theories. Part IV is designed to give some understanding of the problems of self-improvement faced by the science teaching profession. Each chapter includes a bibliography.

Goldstein, Philip. How to do an experiment. New York, N.Y., Harcourt, Brace and Company, Inc., 1957. 192 p.

The purpose of this book for high school students is to help them learn to do scientific research. It describes the methods which practising scientists use - choosing and stating a problem; bibliographical techniques; recording observations; preparation of graphs, tables, and diagrams; analysing data and drawing conclusions. It gives detailed information on preparation of the written report and provides a sample report. A final chapter outlines the fundamentals of statistics which high school students might use in research projects. An extensive bibliography includes publications on the history and methods of science, how to carry on an investigation, research techniques, and sources of ideas for projects.

Lawson, Chester A.; Paulson, Richard E. (ed.). Laboratory and field studies in biology; (teachers' edition). New York, N.Y., Holt, Rinehart and Winston, Inc., 1960. 500 p.

This is part of a broad effort to improve biology teaching by augmenting the teacher's background; it was written by a committee of university professors and classroom teachers of biology. It is a source book divided into sections on the ecological, biochemical, taxonomic, physiological, and evolutionary aspects of organisms. Each section contains a number of studies any one of which can be lifted out of context and used independently of the others. Each study has an introduction, followed by a set of open-ended directions and suggestions for analysing data and drawing conclusions.

Mills, Lester C.; Dean, Peter M. Problem-solving methods in science teaching. The Science Manpower Project. New York, N.Y., Bureau of Publications, Teachers' College, Columbia University, 1960. 88 p.

An introduction to the general subject of problem-solving is followed by chapters containing numerous specific examples from earth science, biology, and physical science. A final chapter suggests methods of evaluating problem-solving skills.

Morholt, Evelyn; Brandwein, Paul F.; Alexander, Joseph. Teaching high school science: a source book for the biological sciences. New York, N.Y., Harcourt, Brace and Company, Inc., 1958. 506 p.

The techniques and procedures described here were selected from fifty-eight courses as ones which teachers might want to use in their own classes. The first chapter is an introduction to the purposes and common patterns of laboratory work. The succeeding twenty-two chapters contain descriptions of classroom-tested techniques from different fields of biology, suggestions for introducing them in the classroom, and lists of references, films, and other teaching materials.

Munzer, Martha; Brandwein, Paul F. Teaching science through conservation. New York, N.Y., McGraw-Hill Book Company, 1960. 469 p.

This practical aid to science teachers presents selected classroom, laboratory, and field procedures in conservation (resource-use) which have been tested in the classroom. Content is broken down according to both subject areas and interrelationship of subjects. The appendix includes lists of supply houses, reagents, and suggested laboratory and field trip procedures. There is an extensive bibliography.

_____. Teaching by television. Second Edition. New York, N.Y., The Ford Foundation

and the Fund for the Advancement of Education, 1961. 87 p.

This bulletin describes the use of educational television in four communities and lists over twenty other school systems which are willing to provide information about their experiences with the use of this medium.

Richardson, John S. Science teaching in secondary schools. Prentice-Hall Education Series. Englewood Cliffs, N.J., Prentice-Hall, Inc., 1957. 385 p.

Introductory chapters deal with principles underlying science teaching. There are sections describing methods and procedures appropriate for science teaching and suggesting how the methods of science can be taught in high school science classes.

Thurber, Walter A.; Collette, Alfred T. Teaching science in today's secondary schools. Boston, Massachusetts, Allyn and Bacon, Inc., 1959. 640 p.

Presents the philosophical and psychological backgrounds of high school science teaching, as well as special techniques the beginning teacher will need to know.

Washton, Nathan S. Science teaching in the secondary school. New York, N.Y., Harper and Brothers, 1961. 328 p. Education for Living Series.

Several chapters are devoted to curriculum planning and selecting and organizing science materials. Two chapters describe special techniques for teaching biological and physical sciences; others are devoted to problems common to all the secondary sciences - problem-solving, use of audio-visual aids, reading materials, evaluation, and planning new classrooms and laboratories.

REPORTS, STUDIES, AND RECOMMENDATIONS

Academically Talented Student Project. Science for the academically talented student. Washington, D.C., National Education Association and the National Science Teachers' Association, 1959, 63 p.

This publication for secondary school teachers and administrators is one of a series published by the Academically Talented Student Project. It provides nine guidelines by which science content may be selected for high school youth of greater ability. Examples from the biological and physical sciences illustrate the application of each guideline. Special methods and resources found to be effective are described. The training and personal characteristics needed by the teacher of the academically talented are discussed. A final section suggests a programme in science.

Barnard, J. Darrell (chairman). Rethinking science education. The Fifty-ninth Yearbook of the National Society for the Study of Education, Part I. Chicago, Illinois, National Society for the Study of Education, 1960. 344 p.

This is a valuable statement on preferred practice and the direction of thinking in science education in the United States. Chapter V, The Status of Science Teaching in Elementary and Secondary Schools, will be of particular interest abroad. Of equal interest are Chapter IX on improving secondary school science, Chapter X on auxiliary efforts to improve secondary school science efforts, and Chapter XI on organization and administration for curriculum development. Chapters XIII and XIV, dealing with school facilities and training of science teachers, should also make a valuable contribution overseas.

Brown, Kenneth E.; Obourn, Ellsworth S. Offerings and enrolments in science and mathematics. Washington, D.C., U.S. Government Printing Office, 1958. 44 p. (U.S. Office of Education Pamphlet no. 120).

The data upon which this study is based were secured by a selective sampling of about twenty per cent of the public high schools in the United States. Data for science and mathematics were tabulated and analysed separately. In both fields, trends in emphasis and in curriculum revision were noted and enrolments in separate subjects (i.e., biology, physics, or trigonometry) were indicated. Generalizations for the country as a whole were drawn from these data.

Brown, Kenneth E.; Obourn, Ellsworth S. Qualifications and teaching loads of mathematics and science teachers. Washington, D.C., U.S. Government Printing Office, 1959. 101 p. (U.S. Office of Education Circular no. 575).

The study includes information on the amount of preparation teachers have had in their subject specialties, in other fields, and in education subjects; the recency of their preparation, their highest degrees, and the type and location of their undergraduate colleges. The study also shows class sizes, the number of pupils per teacher per day, teaching combinations and such general information as the marital status, age distribution, and race of teachers. The data for this study were secured by a sampling of schools in three States - Maryland, New Jersey, and Virginia.

Cole, Charles C., Jr. Encouraging scientific talent. Princeton, N.J., College Entrance Examination Board, Educational Testing Service, 1956. 260 p.

This study brings together the results of much research and numerous observations on the nature of scientific talent. It cites statistical data and case histories from studies of loss of talent between high school and college, and suggests methods of preventing this. Extensive bibliography.

Hurd, Paul DeH. Biological education in American secondary schools, 1890-1960. Boulder, Colo., Biological Sciences Curriculum Study, 1961. 263 p.

Part I provides a historical survey of practices in the teaching of high school biology, based principally on a study of committee reports. Part II outlines the history of high school biology as revealed by research investigations of curriculum and learning problems.

Joint Commission on the Education of Teachers of Science and Mathematics. Improving science and mathematics programs in American schools. Washington, D. C., American Association for the Advancement of Science and the American Association of Colleges for Teacher Education, 1960. 41 p.

This report by the Joint Commission describes the status of science and mathematics education in American elementary and secondary schools and makes recommendations for the improvement of instruction in both subjects. The problems of recruitment of science and mathematics teachers are investigated and specific minimum requirements for pre- and in-service training are described.

National Commission on Teacher Education and Professional Standards. The education of teachers: curriculum programs. Washington, D. C., National Education Association of the United States, 1959. 453 p.

This book, written by and for those concerned with the training of elementary and secondary school science teachers, presents the addresses delivered at a conference on teacher education, a summary of the conclusions reached in group discussions, and the content of working papers. One of the papers summarizes the quantitative requirements in teacher education programmes in 294 institutions. The remainder of the report describes details of programmes in some forty colleges and universities.

National Science Foundation. Statistical handbook of science education. Washington, D. C., U. S. Government Printing Office, 1960. 94 p.

This source book for those concerned with scientific and educational matters, particularly the training of scientific manpower, is divided into three parts. Part I deals with human resources, Part II with training in the sciences, and Part III is a statistical appendix.

National Science Teachers' Association. New developments in high school science teaching. Washington, D. C., the Association, 1960. 108 p.

The report of a study of new and promising practices in science teaching, grades 7-12. Contains chapters on the secondary science subjects (general science, earth-space science, physical science, biology, physics, and chemistry), science seminars, and such administrative problems as in-service training of teachers, use of community resources, and extending the school day to out-of-school hours.

National Science Teachers' Association. Planning for excellence in high school science. Washington, D. C., the Association, 1961. 67 p.

This publication is the result of a work conference held to develop guidelines for redesigning secondary school science programmes. Part I deals with the nature of educational and scientific enterprises; Part II, with their implications for the science programmes, administration, and teacher training in the secondary school.

Obourn Ellsworth S.; Koelsche, Charles L. Analysis of research in the teaching of science: July 1956-July 1957. Washington, D. C., U. S. Government Printing Office, 1959. 46 p. (U. S. Office of Education Bulletin 1960, no. 2.)

This publication forming part of a series of bulletins prepared jointly by the National Association for Research in Science Teaching and the U. S. Office of Education summarizes fifty-four research studies. Criteria for the inclusion of studies were predetermined; these are arranged according to level of instruction - elementary, secondary and college.

NATIONAL CURRICULUM STUDIES

Biological Sciences Curriculum Study, Gifted Student Committee, Brandwein, Paul F., chairman. Biological investigations for secondary school students. Boulder, Colo., University of Colorado, 1961. 402 p.

Contains outlines of prospectuses of 100 selected unsolved biological problems. Each outline gives the background of the problem, a suggested approach and references. Through these open-ended activities students of greater than average ability can develop skill in solving scientific problems.

Biological Sciences Curriculum Study. High school biology. Boulder, Colo., University of Colorado, 1961, (three versions and teacher's handbook).

The blue version textbook and laboratory manual develops the fundamental concepts of biology with particular emphasis upon the biochemical aspects of life. The yellow version represents a traditional approach covering the biology of the cell; the biology of man, plants, and animals; variety in the plant and animal kingdoms; genetics; reproduction and development; evolution; and man and nature. The green version is built around a natural history, or ecological, approach to biology.

College Entrance Examination Board. Advanced placement programme syllabus. New York,

N.Y., College Entrance Examination Board, 1958. 137 p.

Successful completion of the advanced placement examination in a subject provides a secondary school student with advanced placement in the college course, college credit, or both. This booklet outlines course-content recommendations in biology, chemistry, and physics. Advanced placement courses are based on a more mature presentation of subject matter and more extensive laboratory experience than is usual in high schools.

Chemical Bond Approach Committee. Chemistry. Vol. I, 1960; Vol. II, 1961. Portland, Oregon, The Reed Institute. 563 p.

A recent conference recommended that three bond types be included in chemistry courses - ionic, covalent, and metallic. The type of bond is used to explain molecular structures of substances and their chemical and physical properties. The laboratory manual is based on a research philosophy which encourages students to solve problems and extend their knowledge.

Chemical Education Material Study Staff, J.A. Campbell, Director. Chemistry, an experimental science. Claremont, California, Chemical Education Material Study, Harvey Mudd College, 1961.

The heart of the CHEMS course is its experimental approach. A new topic is usually introduced through experimentation which is integrated with the text. The course is organized around theories and principles, facts being given in substantiation of the theories.

Fischler, Abraham S. Modern junior high school science. New York, N.Y., Bureau of Publications, Teachers' College, Columbia University, 1961. 127 p. (Science Manpower Project Monographs).

This monograph for teachers outlines a seventh-, eighth-, and ninth-grade science sequence with a limited number of units a year, thus facilitating study in depth of important topics. The three courses are entitled, respectively, "The Environment and Human Needs", "Use and Control of Energy", and "Frontiers of Science". Each unit is outlined, first, in terms of principles of science involved and, second, according to a suggested topical order. Bibliographies for teachers and students are also given, followed by a general discussion of the unit.

_____. Modern high school physics. New York, N.Y., Bureau of Publications, Teachers' College, Columbia University, 1959. 70 p. (Science Manpower Project Monographs, Second Edition).

This modern course may be used as it stands, or may be modified to meet local requirements. The main headings are: Foundation of Mechanics; Wave Motion; Heat Energy; The Nature and Propagation of Light; Electricity, Magnetism, and Electronics; Nuclear Energy; Relativity; and Recent Advances in Physics. Each of the above topics is outlined for the teacher, and its implications for his teaching are discussed in some detail.

Physical Science Study Committee. Physics (and teachers' handbook). Boston, Massachusetts, D.C. Heath and Company, 1960. 656 p.

The PSSC course is modern in content, emphasizing the quantum approach and wave mechanics and omitting the technological application often found in high school courses. It is divided into four parts: The Universe, Optics and Waves, Mechanics, and Electricity and Atomic Structure. Few schools using the course require more than algebra and plane geometry, although additional mathematics would be of value.

The PSSC course was planned by a group of university and secondary school teachers under a grant from the National Science Foundation.

Pierce, Edward F. Modern high school chemistry. New York, N.Y., Bureau of Publications, Teachers' College, Columbia University, 1960. 109 p. (Science Manpower Project Monographs).

This monograph is based on a framework of logically developed concepts of energy, atomic structure, and equilibrium.

Stone, Dorothy F. Modern high school biology. New York, N.Y., Bureau of Publications, Teachers' College, Columbia University, 1959. 96 p. (Science Manpower Project Monographs).

The proposed course has one unifying theme - "The behaviour of living things is ordered by the constantly changing influences of their biological, chemical, physical, and social environments." It omits much technological material formerly included in high school biology, providing time for study in greater depth of the underlying principles of biological science. Six units are outlined: Chemical and Physical Aspects of Life, Structure and Function of Living Things, Intra- and Inter-dependencies of Life, Reproduction, Genetics, and Changing Things.

BIBLIOGRAPHIES AND LISTS

Antonini, Josephine S. (ed.). Educational film guide, 1954-58 (and supplements, 1959, 1960). New York, N.Y., H.W. Wilson Company, 1958. 448 p.

Includes titles of educational films on all subjects released since 1953. Each film is indexed by title and subject, and information provided by the manufacturer is given for each entry. A list of the sources from which films may be obtained is included.

Buros, Oskar Krisen (ed.). The fifth mental measurements yearbook. Highland Park, N.J. The Gryphon Press, 1959. 1,292 p.

Reviews over 900 tests at the elementary, secondary, and college levels. Tests are indexed by subject, title, and author.

Deason, Hilary J. (ed.). The AAAS science book list. Washington, D.C., American Association for the Advancement of Science, 1959. 140 p.

Content of books in this annotated listing have been evaluated. Reading difficulty ranges from books suitable for junior high school students to others for exceptionally able junior college students. Subject, author, and title indexes.

Deason, Hilary J.; Lynn, Robert W. (ed.). An inexpensive science library. Fourth Edition. Washington, D.C., American Association for the Advancement of Science, 1960. 70 p.

A selected list of 500 paper-bound science books. Each volume is annotated and indexed by topic, title, and author.

Deason, Hilary J. (ed.). The traveling high school science library. Fifth Edition. Washington, D.C., American Association for the Advancement of Science, 1959. 61 p.

The purpose of the programme is to provide good science reading material in communities where library facilities are poor. Under the programme the 200 selected books listed in this booklet are loaned in lots of twenty-five to schools requesting them.

Joint Committee of the American Library Association, National Education Association and National Council of Teachers of English, Mary Anna McAllister, chairman. A basic book collection for high schools. Sixth Edition. Washington, D.C., American Library Association, 1957, 196 p.

Joint Commmitte of the American Library Association, National Education Association and National Council of Teachers of English, Margaret V. Spengler, chairman. A basic book collection for junior high schools. Third Edition Washington, D.C., American Library Association, 1960, 144 p.

The purpose of these collections is to assist secondary schools in the selection of books and to serve as a library checklist. Annotations and author, title and subject indexes.

_____. Textbooks in print. Compiled at the Office of Publisher's Weekly. New York, N.Y., R.R. Bowker Company, 1961.

This bibliography lists all American elementary and secondary school texts by subject, author, and title. Also gives price and publisher.

SCIENCE COURSES ON FILM

American Institute of Biological Sciences. Biological science film series. New York, N.Y., McGraw-Hill Book Company, Inc., 1961.

A series of 120 thirty-minute films on the following subjects: cell biology, microbiology, multicellular plants, multicellular animals, reproduction and development, genetics, plant diversity, animal diversity, ecology, and evolution. A number of themes, including homeostasis, evolution, and ecology run through the series. Each part is directed by a co-ordinating teacher who organized the materials and acted as the continuing teacher for that part.

Baxter, John F. Chemistry, an introductory course. Wilmette, Ill., Encyclopaedia Britannica Films, Inc., 1959.

This series of 160 thirty-minute films is available only as a complete course. It is a modern course designed to meet the needs both of students who do not intend to continue scientific study and those who will do so.

_____. Continental classroom: modern chemistry. New York, N.Y., Learning Resources Institute, 1960.

The teacher in this series of 160 films is assisted by a number of eminent guest lecturers. The course is essentially a modern one emphasizing the theory of chemistry rather than descriptive materials. Bonding is stressed. Ten lectures on various aspects of biochemistry have been included. Intended primarily to improve chemistry teachers' academic backgrounds.

Koppelman, Ray. Continental classroom: the new biology. New York, N.Y., Learning Resources Institute, 1961.

A series of 160 thirty-minute biology lessons to be presented initially on television during the 1961-62 academic year. The course will emphasize (1) the biochemical aspects of organisms, (2) biological problems of tomorrow, (3) man in his relation to the living and non-living world, and (4) the scientist's methods of inquiry. A lesson guide will be prepared for the series.

Physical Science Study Committee. Physics. Watertown, Mass., Educational Services, Inc., 1958.

Forty-three films are at present available in the series, ranging in running-time from seven to thirty-three minutes. They are part of a complete physics course prepared by the Physical Science Study Committee at the Massachusetts Institute of Technology. Accompanying materials include a textbook, laboratory apparatus, tests, and a monograph series. The course emphasizes modern physics - the quantum approach and wave mechanics.

White, Harvey E. Continental classroom: atomic age physics. New York, N.Y., Learning Resources Institute, 1959.

Both laboratory and lecture lessons have been included in this series of 160 thirty-minute films.

The printed lesson synopses contain suggested textbook references and problem assignments as well as the lesson summary. Major topics include kinematics, light dynamics, electricity, magnetism, and atomic and nuclear physics.

Like the two other film series of the Learning Resources Institute, Atomic age physics was intended to bring up to date the science backgrounds of teachers. Also of use in high school and college physics courses and for those of the general public who wish to know more about science.

White, Harvey E. Introductory physics. Wilmette, Ill., Encyclopaedia Britannica Films, Inc., 1958.

This complete physics course on film, prepared and taught by Harvey E. White, has 162 thirty-minute filmed lecture and laboratory sessions. Topics covered are conventional mechanics, properties of matter, heat, sound, light, electricity, and magnetism, atomic physics, electronics, quantum optics, and nuclear physics. Textbooks and teachers' manuals accompany the series, and several student workbooks have been prepared.

FACILITIES AND EQUIPMENT

Council of Chief State School Officers. Purchase guide for programme in science, mathematics, and modern foreign languages. Boston, Mass., Ginn and Company, 1959. 336 p. (Request supplement).

Contains a list of equipment for use in elementary and secondary school science courses, and gives specifications for all items listed.

Hurd, Paul DeH. Science facilities for the modern high school. Stamford, Calif., Stamford University Press, 1954. 52 p. (Educational Administration Monograph no. 2).

Describes recent developments in secondary school science teaching and shows how science rooms, facilities outside the classroom, and equipment and furnishing can be developed to meet needs created by these modern trends.

Koelsche, Charles L. and Solberg, Archie N. Facilities and equipment available for teaching science in public high schools, 1958-1959. Toledo, Ohio, Research Foundation, University of Toledo, 1959. 71 p.

This bulletin presents one method of studying existing science teaching facilities. Data from a sampling of 800-odd high schools in seven states were secured by visits to schools and through conferences with school administrators and teachers. Information was collected on check lists. Data for each state were transferred to IBM punch cards and machine-processed. Findings indicated that there was considerable variation in the quantity and quality of science facilities and equipment, and that this variation was in favour of the large high school.

Lumsdaine, A. A. and Glaser, Robert. Teaching machines and programmed learning: a source book. Washington, D. C., National Education Association, 1960. 724 p.

A comprehensive source book on the different types of teaching machines, including Pressey's self-instructional test-scoring devices and Skinner's teaching machines and the techniques for using the new instructional medium. It reports on use of machines in a number of teaching situations and the problems of programming materials for instruction.

Martin, W. Edgar. Facilities and equipment for science and mathematics: requirements and recommendations for state departments of education. Washington, D. C., U. S. Government Printing Office, 1960. 130 p. (U. S. Office of Education Miscellaneous Bulletin no. 34).

A state by state list of requirements for science and mathematics. Gives general statements on requirements for elementary and secondary schools. The discussion of secondary school facilities includes size and types of science rooms, storage space and work-rooms, utilities, heating and ventilation, furniture and equipment.

_____. Facilities, equipment, and instructional materials for the science program. Chapter XIII of the Fifty-ninth Yearbook of the National Society for the Study of Education, Part I, Rethinking Science Education. Chicago, Illinois, The National Society for the Study of Education (distributed by the University of Chicago Press), 1960, p. 229-257. Reprint free from the author, U. S. Office of Education, Washington 25, D. C.

This chapter deals with the problems arising in connexion with facilities, equipment, and materials for the elementary and secondary school. One section deals with space requirements, furniture, auxiliary science rooms for teaching high school science, and requirements of the specialized sciences. Another sets out guiding principles for selection of furniture and equipment. One chapter is devoted to the need for approaching the problem of facilities and equipment in the light of recent emphases in science teaching - newer media, modern subject matter, and 'open-ended' student experiences.

McCollum, Howard P. Let's look at our facilities for teaching science. Baton Rouge, Louisiana, Shelby M. Jackson, State Supt. of Public Education, 1960. 64 p.

Some general considerations concerning the planning of facilities for science instruction; check lists of facilities for teaching general science, biology, chemistry, and physics.

Department of Audio-Visual Instruction. Planning schools for use of audio-visual materials, no. 1 - Classrooms. Third Edition (revised March 1958).

Washington, D. C., National Education Association, 1958. 63 p.

Photographs, diagrams, and text indicate how classrooms can be designed for use and storage of projection equipment, television, and small group and individual activities; how utilities can most effectively be provided; and how lighting can be provided and controlled.

Department of Audio-Visual Instruction. Planning schools for use of audio-visual materials, no. 2 - Auditoriums. Washington, D.C., National Education Association, 1953 (February), 36 p.

This publication describes ways of solving problems of seating arrangement, activity space, acoustics, ventilation, wiring and light control, speakers and screens, and selection of equipment for school auditoriums.

Richardson, John S. (ed.). School facilities for science instruction. Washington, D.C., National Science Teachers' Association, 1954. 266 p.

This work has chapters on the multipurpose science room, general science, biology, chemistry, and physics. Each chapter covers classroom and laboratory facilities, utilities, services, equipment, and supplies and the problems of storage, room-planning, and use of other school and community resources. A check list of facilities completes the chapter.

PERIODICALS

The American biology teacher. National Association of Biology Teachers. P. Webster, Bryan City Schools, Bryan, Ohio. Published monthly (Oct. -May).

Contains articles about the teaching of secondary school biology.

The American journal of physics. American Association of Physics Teachers. American Institute of Physics, Inc., 335 East 45th Street, New York 17, N.Y. Published monthly (Sept. -May).

A technical journal for secondary and university physics teachers and students.

Chemical and engineering news. American Chemical Society, 1155 16th Street, N.W. Washington, D.C. Published weekly.

A technical journal of chemistry and engineering.

The journal of chemical education. American Chemical Society, Division of Chemical Education. American Chemical Society, 20th and Northampton Streets, Easton, Pa. Published monthly.

For secondary and university chemistry teachers and students.

Physics today. American Institute of Physics, 335 East 45th Street, New York, 17, N.Y. Published monthly.

A journal for physics teachers and advanced students with articles of general interest.

School science and mathematics. Central Association of Science and Mathematics Teachers, Inc., 450 Ahnaip Street, Menasha, Wis. Published monthly (Oct. -June).

Contains articles of interest to elementary and secondary science and mathematics teachers.

Science (incorporating Scientific monthly). American Association for the Advancement of Science, 1515 Massachusetts Avenue, N.W., Washington 5, D.C. Published weekly.

Technical articles on current research for teachers and students in advanced secondary school science subjects.

Science digest. Science Digest, Inc., 200 East Ontario Street, Chicago 11, Ill. Published monthly.

Non-technical articles for all science teachers and secondary school science students.

Science education. National Association for Research in Science Teaching; Council of Elementary Science International. C.M. Pruitt, University of Tampa, Tampa, Fla. Published five times a year.

Recent research in science teaching at the elementary, secondary and university levels.

Science newsletter. Science Service, Inc., 1719 "N" Street, N.W., Washington 6, D.C. Published weekly.

A weekly summary of current happenings in science for elementary and secondary school students and teachers.

The science teacher. National Science Teacher Association, 1201 16th Street, N.W., Washington 6, D.C. Published eight times a year.

A publication for all science teachers.

Science world. Scholastic Magazine Inc., 33 West 42nd Street, New York 36, N.Y. Published bi-weekly.

A news sheet of current science for secondary school students. Accompanied by a teachers' edition.

Scientific American. Scientific American Inc., 415 Madison Avenue, New York 17, N.Y. Published monthly.

A technical journal for science teachers and more able students.

Sky and telescope. Sky Publishing Corporation, Harvard College Observatory, Cambridge 38, Massachusetts. Published monthly.

Semi-technical journal for teachers and high school students. A monthly sky map is included in each issue.

URUGUAY

(Submitted by the National Commission for Unesco)

Science teachers for secondary schools are trained at the Instituto Artigas, a specialized centre for this branch of education. In addition to studying their special subject, students are required to take courses in education. The library of the Instituto Artigas is open to its students and laboratory facilities are available in other faculties.

VIET-NAM

(Submitted by the National Commission for Unesco)

All questions concerning science teaching, study plans, syllabuses and curricula come under the Directorate of Secondary and Primary Education.

Previously, up to 1959, teachers were recruited from among :

holders of the licence ès sciences, for the second cycle ;

holders of the diploma of the former Ecole supérieure de pédagogie, Hanoi, for the first cycle.

The latter, who had taken their baccalauréat (second part) and had competed for admission to the Ecole supérieure were given a varied training there over a period of two years.

Starting in the 1958-1959 school year, in Saigon, the Faculty of Pedagogy, became a training centre for secondary school teachers like its predecessor in Hanoi.

There are two separate kinds of training on the science side : the first is accelerated, and lasts one year, while, the second, or standard course of training lasts three years. Accelerated training comprises two sections : mathematics and physical sciences, and natural and physical sciences. Standard training comprises three sections : mathematics, physical sciences, natural sciences.

The students are recruited by competition from among holders of the second part of the baccalauréat. Those given accelerated training are appointed to teach in the first cycle ; those who have taken the full course become teachers in the second cycle.

It is still open for holders of a licence ès sciences to be appointed probationally as teachers in secondary schools on the basis of their qualifications.

The diplomas of the Faculty of Pedagogy are on the same level as the licence ès sciences. Apart from showing the required professional aptitudes and a knowledge of two foreign languages, teacher trainees are required to have covered the curriculum for the following certificates of the Faculty of Science : for the mathematics section - general mathematics and physics, differential and integral calculus, rational mechanics ; for the physical sciences section - mathematics, physics and chemistry, general physics, general chemistry. For the natural sciences section - general science, general botany, general zoology.

At least one hour of French and one hour of English a week are taught in all sections during the three-year course. The curriculum for professional studies includes psycho-pedagogy, sociology, school regulations, hygiene and first aid. A period of practice teaching is compulsory in the second and third years.

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